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THE PSYCHOLOGICAL REVIEW

SPEECH REACTIONS AND THE PHENOMENA OF APHASIA

BY ARTHUR ERNEST DAVIES

Colorado Springs

In this paper I propose to examine the motor theory of the 'speech reactions' of behaviorism from the standpoint of the disturbances of speech behavior in what is known as aphasia. I shall inquire whether sensory qualities or sensations, that is, the perception of word sounds and of word sense are or are not an integral part of our speech performance, and whether functional units corresponding to these exist in the cortex, and if so what their relation is to the mechanism upon which articulation, that is, the sub-innervation of the vocal cords, depends. The position of behaviorism is bound up with the view that the central nervous system is only a complex coördinating mechanism interposed between the sensory and motor components of reflex activities, and, therefore, that it adds nothing new to the impulses that pass from the peripherally located receptor to the peripherally located effector. If the phenomena of aphasia show that this is not the case, but that word movements (articulation) are conditioned in their origin by word sounds (the hearing of words) and word sense (the meaning of words), I shall regard this as a serious objection to the peripheral theory that holds that the cortical centers are neutral with respect to behavior, and to the interpretation that behaviorism places upon our speech reactions in its explanation of behavior.

My discussion falls into four main sections. In the first place, I shall state rather carefully certain fundamental principles of behaviorism for the purpose of showing the

position of the speech reactions in that system and what the nature of these reactions is.[1] Secondly, I shall deal with the general question of speech disturbances, mainly from the historical point of view, for the purpose of distinguishing the phenomena of aphasia from them, and of showing that it was only when our knowledge of the central cortical mechanisms was sufficiently developed that the clinical descriptions of aphasic phenomena came to be understood. Thirdly, I shall describe the main types of aphasia and their relation to one another in so far as the study of this subject has thrown light upon the specific centers on which the several forms of our normal speech depend. I shall limit myself to the consideration of the main types of aphasia because it is not necessary to go beyond this for an understanding of the physiology of what behaviorism calls our speech reactions. Fourthly, I shall consider briefly the speech reactions of behaviorism in the light that aphasia throws upon our knowledge of the speech complex of normal individuals, and shall endeavor to estimate the value and limitations of the behaviorists' employment of the speech mechanisms in the explanation of behavior.

I

The motives which prompt the behaviorist to assign to the speech reactions of the normal individual the primary rôle of 'thought,' and the particular benefit that is expected to accrue from this substitution of speech for images or ideas, are stated by Watson in the following passage. He says that "the most serious obstacle in the way of a free passage from structuralism to behaviorism is the centrally aroused sensation or image. If thoughts go on in terms of centrally aroused sensations, as is maintained by the majority of both structural and functional psychologists, we should have to

[1] I have found it convenient to develop the discussion with reference to a classic passage from Watson, but I have had in mind more than the personal views of any single representative of behaviorism, and have kept before me, so far as I could, the body of views that is known as behaviorism. As we know it today, behaviorism is, of course, the resultant of the concretion of opinions contributed by many individuals who differ among themselves on many points of emphasis and detail.

admit that there is a serious limitation on the side of method in behaviorism. Imagery, from Galton on, has been the inner stronghold of a psychology based on introspection. All of the outer defences might be given over to the enemy, but the cause could never be wholly lost so long as the pass (introspection) to this stronghold (images) could be maintained. . . . It is this type of implicit behavior that the introspectionist claims as his own and denies to us, because the neural seat is cortical and because it goes on without adequate bodily portrayal. Why in psychology the stage for the neural drama was ever transferred from periphery to cortex remains somewhat of a mystery. The old idea of strict localization of brain function is in part responsible. I feel, however, that religious convictions are even more largely responsible for it. I do not mean that the men originally responsible for the transfer were aware of this tendency at all. When the psychologist threw away the soul he compromised with his conscience by setting up a 'mind' which was to remain always hidden and difficult of access. The transfer from periphery to cortex has been the incentive for driving psychology into vain and fruitless searches of the unknown and unknowable. I am quite sure if the idea of the image had never taken such a firm hold upon us we would never have originated the notion that we are seeking to explain consciousness. We would have been content to study the very tangible phenomena of the growth and control of explicit and implicit habits.

"It is implied in my words that there exists or ought to exist a method of observing implicit behavior. There is none at present. The larynx, I believe, is the seat of most of the phenomena. If its movements could be adequately portrayed we should obtain a record similar in character to that of the phonogram. Certainly nothing so definite as this could be obtained, but we should get a record, at least, which would largely reveal the subject's word-habits, which, if I am not mistaken, make up the bulk of the implicit forms of behavior.

"Now it is admitted by all of us that words spoken or

faintly articulated belong really in the realm of behavior as much as do movements of arms and legs. If implicit behavior can be shown to consist of nothing but word-movements, the behavior of human beings as a whole is as open to objective observation as is behavior of the lowest organisms.

"It is implied here and elsewhere in my position that there is no scientific value (or at most only temporary and provisional value) in self-observation. I sincerely believe that psychology would make far more rapid progress in the next twenty-five years than in all its previous history if it would conduct its experiments upon the assumption that the (normal) subject can hear but cannot innervate the speech musculature beyond the point of making *silent* whispers. The same result might be obtained by working upon the assumption that the experimenter is deaf." [2]

From this statement, which represents the mood and attitude and in some respects the program of behaviorism in the earlier days of its existence, the strict behaviorist has never departed. The work done since these words were written has given a greater confidence to the movement; it has added more detailed information, opened up newer lines of investigation, and found for itself broader fields of application. After a little more than a decade, it has been possible even to formulate the theoretical bases of behaviorism. Whatever one's personal views may be on the subjects it treats and the problems it considers, behaviorism stands before us to day as a substantial achievement, a definitely articulated whole of parts, the most novel and spectacularly interesting of the changes that, in the past twenty years or so, have borne witness to the vitality of psychology in the modern era. We are all interested in behaviorism, if we are not all behaviorists, and it is sometimes important to remind ourselves of its earlier beginnings. Both for this reason and because of the light it throws on the subject of this paper, I shall summarize the long quotation with which I began.

In its earlier formulation, as well as in its later developments, behaviorism may be defined as a study of the peri-

[2] Watson, J. B., 'Behavior,' pp. 16–21.

pheral contacts of organic life (animals and men) with, and their reactions to, the material universe with which it is in a causal relation. It began, therefore, with a series of repudiations of whatever interfered with this conception of the proper business of psychology. The passage I have quoted discovers three interconnected hindrances to the carrying out of the behaviorist's program, and these are presented as three reasons why psychology has remained, as is claimed, an unprogressive science. One of these is neurological, the other religious, and the third psychological. The neurological hindrance to our understanding of behavior is said to be 'the old idea of strict localization of brain function.' Not a few of us felt at the time that this statement was first expressed, and many have felt since, that this was only a hint or illustration of the kind of thing that was meant, and that what was proposed was, practically, the scrapping of the whole central nervous system as a principle of explanation in psychology.[3] A concrete confirmation of this interpretation is found in the contrast between Watson's treatment of what, in his more recent work, he calls 'emotional organization,' and McDougall's well-known view of the instincts, a contrast that falls within the general field of what I should prefer to call 'emotional dispositions.' Watson calls us back to 'primitive common sense,' to that, namely, of the 'primitive behaviorists in the Dark Ages,' who, he affirms, 'rightly spoke of their heart, lungs, and bowels as the organs of emotional response';[4] McDougall, recognizing the primacy of the cognitive, that is, the central factors, maintains that the emotional qualities of any situation, like the sensory, can only be indicated by pointing to the situation or object and saying that the emotion is 'what I experience when I perceive or think of that.'[5] I am not concerned in this illustration about the views that these writers entertain, for example,

[3] The justness of this impression is confirmed by discussions that have taken place since, among behaviorists themselves; and their importance for behaviorism is seen in the fact that we may distinguish different groups of behaviorists on the basis of the views they take on this subject.

[4] 'Kinæsthetic Organization in Thinking,' PSYCHOL. REV., 1924, 31, p. 344.

[5] 'Outlines of Psychology,' p. 315.

with regard to the Lange-James theory of emotion; I merely wish to illustrate by contrast the definitely peripheral motives of behaviorism, and to remark that a good deal of the work of the behaviorist group displays a 'purposive striving' against the central nervous mechanism that cannot be interpreted merely as a desire, on their part, to warn us against what they regard as an untenable view of the localization of brain function.

The religious hindrance is in the 'convictions' that psychologists unconsciously entertain with regard to the 'soul.' We are told that in substituting the word 'mind' for 'soul,' the psychologist not only 'compromised with his conscience,' but intended to darken counsel by giving to 'mind' a position that was 'always hidden and difficult of access.' This, of course, is largely pure invention. What may be said is that the change of term indicated a desire on the part of psychologists to get away from certain popular notions connected with the word 'soul,' and to make 'mind' not less but more accessible to scientific observation. It should also be remarked that for scholars, and among these we may at least include some psychologists, the term 'soul' has a different connotation from what it has, for example, for evangelical Christianity, and that both this term (ψυχή) and mind (νοῦς) go back, the former at least to Plato, and the latter to Anaxagoras. In each case, it means whatever it is that makes a thing alive, or what makes behavior possible, and in this sense behaviorism is as much dependent upon the fact of things being alive and upon a theory of their being alive as the rest of us. It is, therefore, only natural to surmise that, in the history of the changes of the name from Anaxagoras forward, the behaviorist has done nothing more than to substitute a physico-chemical or electric term for the psychologist's 'mind,' as the latter is said to have substituted this term for the older term 'soul.' Indeed, it may with some plausibility be maintained that in effecting this change he has reinstated 'mind' in the sense of Anaxagoras by whom, probably, it was used to denote a particularly refined form of matter.

The psychological hindrances are incautiously stated. Forgetting his criticism of the psychologist for "setting up a 'mind' which was to remain always hidden and difficult of access," that is, for his predominating interest in central phenomena, Watson speaks as if originally he did not have such an interest, but, like himself, was concerned with peripheral phenomena. He wonders why "the stage for the neural drama was ever transferred from periphery to cortex," and asserts that this "transfer from periphery to cortex has been the incentive for driving psychology into vain and fruitless searches of the unknown and unknowable." This theory of a 'fall from grace' on the part of psychology is a pretty fiction, and the only purpose it serves is to 'rationalize' the claim of behaviorism to be in the line of the true 'Apostolic Succession.' But, of course, this is nonsense. The true psychologist from Hippocrates down has been interested in both peripheral and central facts, but he has often been hindered by the difficulty of analyzing the massed behavior of everyday life, and for that reason it has been difficult to increase reliably the number of the peripheral phenomena with which he has to deal. As I shall suggest later in the paper, the scientific bankruptcy of behaviorism is to be anticipated just in proportion as it neglects to draw upon the capital reserves that are laid up in the cortex, since it is here that an important part of the causative machinery of behavior is located. The evidence from pathology is quite decisive at this point. But without going so far afield, the question is really only one of whether the proper mode of procedure, in a given case, is to go from the periphery to the cortex, or from the cortex to the periphery; it is ridiculous to define the issue as being one of the exclusive rights of the periphery *versus* the cortex. It is surprising that behaviorists have never been able to agree that it is possible for them to retain both the cortex and periphery without necessarily being dragged, as by an undercurrent, into the admission of 'centrally aroused sensations,' 'images,' or, in a word 'consciousness.' The fear of having to recognize mental processes and results is clearly the motive for discarding the cortical

facts and relations in the formulation of the behaviorists' position. The reasoning by which they arrive at this result is simple and direct: for them 'cortex' means 'images,' and 'images' mean 'consciousness,' and 'consciousness' means 'introspection'; but since 'consciousness' with its implied 'introspection' is the source of all the trouble, let us get rid of the 'cortex' which is its main support and only formidable credential. Thus, we are told, it is the 'firm hold' that 'the idea of the image' has taken that has 'originated the notion that we are seeking to explain consciousness.' A good deal of execution has been done with the beautifully vague and partisan phrase with which this last sentence ends. Indeed, every one who is not a behaviorist is supposed to be wholly absorbed in the task of 'explaining consciousness.' The fact is that, as a psychologist, I have not spent a minute of my existence on any such task. The controversial advantage of the phrase is that in each of its terms concrete particulars are massed and masked so that the psychologist is banished by the behaviorist to some supernal realm in which he is supposed to be seeking to find out what the world of consciousness was like before it came into existence, and to provide its justification. I still maintain that consciousness may mean something concrete and particular, just as the term behavior does, and that all the explanation that is possible in either case is to show in detail the interrelations of the facts in question. Indeed, explanation for science is always confined to showing *how* particular phenomena occur, and has nothing to do with showing *why* they occur. But it is, I suspect, this latter sort of explanation that behaviorism wishes to foist upon the unsuspecting psychologist.[6]

[6] Explanation in the repudiated sense was perhaps the aim of the 'primitive behaviorists (realists?) in the Dark Ages' of whose common sense Watson speaks so highly. It should be remarked, however, that historically it required a philosopher to deliver us from the vanity of such endeavors, and that consequently, since Kant's 'Critique of Rational Psychology,' there has been no ground in fact for accusing psychology, even by implication, of being tangled in the way that is suggested whenever the behaviorist turns his mind critically upon the general character of psychology at the present day. Incidentally, it is an interesting reflection that behaviorism has attracted more public notice among philosophers, especially realists, than it has among the professionally trained psychologist. From this point of view, I could myself get quite excited about it!

The advantage of freeing psychology from the errors to which attention has been called is, according to Watson, that we should then be able unitedly to concentrate our study upon 'the very tangible phenomena of the growth and control of explicit and implicit habits.' Behaviorism holds before itself this clearly defined aim. However, it was inevitable, on account of the greater obscurity and difficulty of the problem, that a good deal more time and care should at first be given to implicit than to explicit behavior. But it would seem that what was merely an accident of the situation is sometimes taken as a general principle of behaviorism, and its representatives often speak as if explicit had to be reduced to implicit behavior which they regard as the typical form of all behavior whatsoever. Implicit habits are believed to have their seat in the larynx, so that if it were possible to get an accurate, say kymographical, record of the contractions that take place in the throat we should be in possession of all the data necessary for interpreting implicit forms of behavior. I want to be clear here, for it is important to know if any and every contraction in the region of the larynx, for example, the contractions in deglutition, constitute part of the behavior here in question. What should be definitely stated is whether they are only those laryngeal contractions of which the innervation of the vocal cords is the primary cause that belong to the category of implicit behavior, or must we also include such changes as are involved, for example, in yawning? Watson says that a record of the behavior of the larynx would give 'the subject's word-habits which form the bulk of the implicit forms of behavior,' and, a little later, suggests that implicit behavior consists of 'nothing but word-movements.' We should infer from this that word-movements are to be included in what he means by implicit behavior, but it leaves us in doubt as to whether laryngeal contractions other than those involved in word-movements belong in the same category of behavior. On the most conservative interpretation, therefore, we may say that two forms of behavior are recognized, explicit and implicit, and that implicit behavior, which is identified with movements of the larynx,

includes the vocal-cord changes that are necessary for the articulation of words, leaving it open if other laryngeal movements also belong to the implicit type of behavior. If this interpretation is correct, the type of behavior that consists in the contraction of the vocal cords in articulation is identical with the well-known 'speech reaction' of behaviorism. These are definitely peripheral phenomena, so that if they "could be adequately portrayed we should obtain a record similar in character to that of the phonogram." This figure, however, is inexact, for, while there is a good deal of uncertainty among individual behaviorists as to whether 'speech reactions' include spoken or uttered words, or whether they also include the word patterns on the printed page, Watson, in the passage before us, says definitely that articulation need only reach the stage of '*silent* whispers,' that is, he identifies it with the sub-innervation of the vocal cords. For this reason, I suggested above that behaviorism would get along very well with a kymographic record of vocal-cord contractions. That *heard* sounds do not belong to the data on which the interpretation of implicit behavior rests is evident when Watson says that behaviorism might work, without detriment to its results, 'upon the assumption that the experimenter is deaf.' [7]

[7] The conditions of experimentation in implicit forms of behavior are, according to Watson, (1) a deaf but speaking experimenter; (2) a hearing but not audibly speaking subject; (3) a method of observing the sub-innervations of the vocal cords. This, I take it, means that spoken words may be used as stimuli, as well as other visual, tactual, olfactory, etc., impressions, but that in no case is the behavior of the subject auditory, visual, tactual, olfactory, etc.; this consists always and exclusively of vocal-cord contractions. The greatest obstacle to carrying out this program, that is, to placing behaviorism upon an experimental basis, is the need of a method by which this type of behavior may be observed. In the passage I quoted, Watson admits that such a method does not exist 'at present.' What, we may ask, have the behaviorists done in the years that have elapsed to supply this crucial necessity of their science? Have any of the energies of the behaviorists been employed in devising an apparatus that will give us the record which, according to their own statements, is necessary if our observations of implicit behavior are to be delivered from the futilities of 'self-observation,' and placed upon the reliable ground of objective observation? Obviously, what is needed is an instrument of precision that will graphically portray the contractions of the vocal cords, a laryngeograph let us say, and it is the failure to develop an instrument so vitally necessary to its scientific existence that is the reason why, instead of finding in books on the subject a series of laryngeograms

Three statements sum up the position of behaviorism so far as I am concerned with it in this paper. The first is that the distinction between explicit or overt behavior is methodological merely, and rests upon the principle that, because of their location within the organism, certain movements are hidden from direct observation. Or, it may be said, the two types of behavior differ in the range or grossness of the movements involved, and that special methods are required to measure the finer movements and to make them available as data of a science of behavior.

Second, behavior, whether explicit or implicit or both, falls into three classes which, in his later work, Watson has called manual, visceral, and laryngeal respectively.[8] By 'manual' is meant the performance of controlled activities of the striated musculature; by visceral is meant the activities of the various organs situated within the body, especially the stomach and ductless glands, that is, in general, the activities of the unstriated musculature; by laryngeal is meant the motor contractions of the throat. In the higher or more complex forms of behavior all three classes are involved, sometimes one and sometimes the other predominating, the visceral for example, in jealousy, the laryngeal in lecturing, and the manual in fancy bicycle riding.

Third, the laryngeal class of behavior is identified with the muscle contractions in the throat which, unless innervated,

that record the characteristics of different kinds of implicit behavior, we have instead a monotonous and largely theoretical extension of the conditioned reflex of the physiologist to nearly all the problems that call for explanation. On the side of its technical development, then, behaviorism is about where it was ten years ago, and that is to say that it cannot compare, in this respect, with the laboratory development that took place in the decade immediately following the introduction of the experimental method in psychology. Behaviorism would, I think, come nearer convincing the psychologist of its value as a method of investigating the problems of behavior if, in addition to speculating on the relation that our very imperfect knowledge of endocrine reactions may possibly have to behavior, it were to make a serious attempt to carry out its original experimental program.

[8] 'Kinæsthetic Organization in Thinking,' PSYCHOL. REV., 1924, 31, pp. 341*f*. This classification is reminiscent of the distinctions of orthodox psychology which recognizes conative (manual), affective (visceral), and cognitive (laryngeal) processes; and the relations of these processes are stated in the way that psychology has made current.

issue in the production of word sounds. Word sounds are not identical with 'speech reactions,' the latter term being employed to denote the changes in the throat mechanism that is the basis of word articulation. Speech reactions, we are told, are as distinctly a peripheral form of behavior as are the movements of the arms and legs.

II

Historical interest in aphasia, as a distinct pathological entity, dates from the year 1861, when Broca reported certain speech defects in the case of one of his patients and gave an anatomical explanation of them. Defects and disturbances of speech, however, have been reported in popular and scientific literature from early times. By speech defects is meant the inability of limited groups of people to pronounce syllables or, in rarer cases, words that present no difficulty to other groups. Modern instances are found in the substitution by Teutonic peoples of the German sound of *w* in English words that begin with *wh*, and, in the cockney dialect of London, in the substitution of the sound of *i* for many of the regular vowels of the language. An historic illustration, from which we get our word shibboleth in the sense of a mark that distinguishes a party or group, is recorded in the Old Testament where it is said that the Gileadites used the pass word 'shibboleth' to eliminate from their company the neighboring Ephraimite who was not able to pronounce *sh*. Disturbances of speech are individual difficulties in the use of language which deprive individuals of the normal facility in the vocal expression of their thoughts. The popular instance of Demosthenes curing himself of stuttering, or whatever the difficulty was, may stand as the classic example of the existence of this class of abnormalities in the speech-producing mechanism. Stuttering, we may suppose, is caused by inattention to the mechanism of speech production, and is always accompanied with nervousness which aggravates the defects of the patient's speech sounds. There is probably no hard and fast line of distinction between speech defects and speech disturbances, but the latter are usually regarded

as pathological while the former are generally regarded as idiosyncrasies.

Theories of speech deficiencies are met with from early times. Aristotle, for example, held that the seat of all vocal sounds was located in the tongue. On the basis of this peripheral view of the speech mechanism, he attempted to explain all deficiencies of speech by referring them to this organ, and they arose, he said, either because the tongue was too short, or too long, or insufficiently motile. This theory has not been borne out by modern research. It is now recognized by the medical profession that while the the tongue may affect the ease and efficiency with which speech sounds are made, it is not, as Aristotle held, the seat of speech. A curious case is reported of the so-called African Disciple of Tipasa who, after his tongue was cut out by the vandal Huneric in 484, was able to proclaim aloud his belief in Christ. In his little book on 'The Tongue not essential to Speech,' which was published in London in 1873, Twistleton, among other things, showed that this was not to be regarded as a miracle. Examples from modern medical literature show that after even extensive operations on the tongue the patient can be taught to articulate words with approximately the same exactness as before. In the face of facts such as these, Aristotle's peripheral theory of speech has been discarded, as, indeed, has his general view that, except for 'reason' which he regarded as a spiritual power, the common mental processes are functions, not of the nervous system, but of the bodily organism. In his general theory of the relation of mind and body, as also in his explanation of speech deficiencies, Hippocrates, before Aristotle's time, was much nearer the modern point of view. About the latter he wrote: "Indistinctness of speech is caused either by disease or by defective hearing, or because, before a thought is expressed, other thoughts arise; before words are spoken, other words are formed." If we connect this observation with the position held by the physicians of the fifth century B.C., among whom Hippocrates was a leading figure, that the mental life in man was a function of his

nervous system, we may see, in a general way, how far, in this respect, Aristotle, three quarters of a century later, was from the best scientific knowledge of his age. It is true that only the most elementary knowledge of the nervous system was available at that time, and that not until the nineteenth century of our era were the details sufficiently known to place psychology upon a sure experimental basis. In our era, it is the development of neurology beyond anything that was dreamed by the ancients that has transformed psychology from an empirical to an explanatory science, and that has undermined the peripheral theories of mental life. Thus, in relation to speech disturbances, Gutzmann, who has made a special study of the peripheral conditions of speech deficiencies, warns us that while irregularity of the teeth, variability of the dental arches, etc., are to be regarded as predisposing conditions of speech disturbances, for example, lisping, they are not to be considered as the explanation of the defects in question, since these may exist without the presence of any such conditions.

I have referred briefly to the existence of a number of speech deficiencies in the community at large, and to their recognition from the time of the ancient Semites to the present day, in order to make it clear that the significance of Broca's contribution to the general problem presented by such cases consists in the fact that he isolated a condition that is to be regarded as distinct from, and independent of, any of these more widely known phenomena. The name he gave to the condition was *aphemia*, because this term described the absence of the ability to speak that was the leading symptom of his patient. It is likely that Broca's report of this case would have attracted only passing attention if he had confined himself to a description of its clinical picture, and that at most he would have become known as having given a term by which any absence of speech could be denoted. It was the fact that Broca regarded the condition as unique, and attributed it to a lesion in a hitherto undifferentiated part of the cerebral hemisphere that fixed the attention of the medical profession upon it, and that in

the years immediately following his discovery gave rise to a number of conflicting opinions regarding the soundness of his position. For example, other clinicians, among whom Trousseau may receive special mention, reported cases of similar speech disturbances which showed at necropsy that the area Broca had assigned for his aphemia was uninjured. The cases reported by Trousseau were similar to those which at the present day are regarded as typical examples of the aphasic symptom-complex, and the anatomical findings were, in every instance, opposed to their localization in the cortical area that Broca contended was the seat of the disturbance he called aphemia. It was inevitable, in view of the contradictory nature of the facts, that physicians should be divided into two opposing groups, and it was this state of affairs that led to the celebrated discussion of the subject in the French Academy in 1864.

This conflict of opinion regarding the disturbances of phonetic speech had to wait for its solution upon the extension of existing knowledge of the physiology and anatomy of the brain. The enlarged and more accurate understanding of the physiology of the brain, when it came, reawakened interest in the clinical picture of Trousseau's aphasia, and, at the same time, led to a correct appreciation of Broca's aphemia, the latter name being discarded, and the term aphasia coming into use for all disturbances, from whatever cause, of phonetic speech. From the fact that at the time of Broca's discovery hopes ran high in regard to the possibility of demonstrating the localization of cerebral functions, supreme importance may be ascribed to the experimental proofs furnished by Fritsch and Hitzig that there are centers in definite areas of the animal brain, which, when stimulated, are followed by the contraction of different groups of muscles. Important as these experiments undoubtedly were, it was the description of the anatomical structure of the animal and human brain, which was made possible by the patient and indomitable labors of Meynert, that gave currency to the new physiological conceptions that were then being defined. Especially significant was the discovery by Meynert

of the projection systems, and the identification of the sensory and motor tracts connecting the organs of special sense with the cortex of the cerebrum, on the one hand, and with the musculature, on the other. Thus, from the physiological standpoint, it came to be seen that stimulations from the body, that is, as we should say today, from the receptors situated at the periphery, are conveyed to the 'sensory sense' of the cerebrum only through the sensory tracts, and that the impulses originating there are then projected over the motor paths to the muscles, or, in modern terminology, to the effectors. Meynert further concluded that the cerebrum may be divided into two large areas, an anterior and a posterior, that the functional importance of the former is largely motor, and that the function of the latter is generally sensory.

It was the application of these general views of the physiology and anatomy of the brain to the contradictions into which discussions of aphasia had led that opened the way, not only for an understanding and resolution of the contradictions themselves, but for a clearer differentiation of, and increase in, the number of the different types of aphasic behavior, and for the more detailed study of the different forms of disturbance of phonetic speech. Thus Wernicke's work on 'The Aphasic Symptom-Complex,' which was published in 1874, was confessedly 'a minute explanation of Meynert's theories, and their special application to human speech.' Others who have worked to place this rather specialized branch of psychoneurology on its present footing are Kussmaul and Bastian, Liepmann, Caro, Déjérine and Charcot.

III

The lines along which the apparent contradiction between Trousseau's cases and Broca's was resolved have, in the main, been indicated. It was, for example, pointed out by Wernicke that we may suppose that there exists in the cortex at least two areas for speech, one in the anterior or motor region of the brain, and one in the posterior or sensory region, and that these may function independently of one

another. There would thus have to be distinguished two types of aphasia, a motor and a sensory, the former corresponding to the condition reported and described by Broca, the latter corresponding to the condition characteristic of the cases reported by Trousseau. These views were fortunately taken out of the field of theory by the anatomical findings in two cases in which a focus of softening was discovered in the posterior half of the first temporal and closely adjacent second temporal convolution of the left hemisphere. We now speak of this location as Wernicke's area, and refer to the type of aphasia that results from the degeneration of this area as sensory, in the same way as the center for speech movements in the third frontal convolution of the left hemisphere is spoken of as Broca's area, and the type of aphasia that results from its degeneration as motor.

The most general feature of motor aphasia, as described by Broca, is *l'impossibilité de parler* (the impossibility of speaking), without other disturbances of the speech mechanism. He defines the condition more carefully in reporting the case of his patient who, he says, had lost *la faculté d'articuler les mots* (the faculty of articulating words); and this conception is supported by a consideration of the process by which a normal child learns to speak. He points out that in this instance we are compelled to draw a distinction between a memory for words and a memory of the movements by which words are articulated. It is well known, for example, that infants hear words and understand what is, in that way, said to them from twenty to thirty months before they may be said to be able to speak in any significant meaning of that term. There is, of course, the beginnings of articulate speech, mostly repetitions of word sounds that are heard, toward the latter end of this period, and the beginning of sentence structure of an elementary kind, but, as Watson says, "an almost unbelievable amount of organization (memory) goes on in infants too young to talk." Organization includes in this connection, if Broca's contention is correct, not only the modification of the cerebral structures that are the basis of the infant's conative (manual) and

affective (visceral) habits, but also the modification of those that underlie his understanding of the situations to which, before the ability to articulate has developed, the infant reacts in numerous ways, and especially of the verbal situations which are so conspicuous a feature of the adult environment in the midst of which his young life is cast. Speaking, therefore, in the normal child is a delayed activity, and, as we shall see more fully later, is preceded by a development of function that is related to the hearing and understanding of word sounds. These latter are not affected, according to Broca, in the type of aphasia he described, and his patient showed that what had been lost was *le souvenir du procédé qu'il faut suivre pour articuler les mots* (the memory of the procedure it is necessary to follow in order to articulate words). That this is the essential fact is supported by the ability of persons suffering from motor aphasia to carry out commands, to produce objects asked for, and to respond intelligently to questions in other than verbal ways.

From these general descriptions, the symptomatology of motor aphasia is quite clear and easy to recognize. In those afflicted by this condition there is observed (*a*) the loss of the ability to articulate words. They have forgotten the procedure by which formerly they produced word sounds. The condition may be present in various degrees from a minimal disturbance of the motor control for words to a complete mutism. Accompanying this symptom there is (*b*) the retention of the power to understand speech. However, on account of the close association of the several structures involved in normal speech, and the nice adjustment of the one to the other, it is not surprising if the disturbance of any one of these influences in some degree the smooth functioning of the others. It may thus occur, as Déjérine has pointed out, that in those affected by motor aphasia the normal understanding of speech is in some degree diminished, and that this is especially noticeable when the sentence structure is complicated and the finer differentiations of speech are involved. With this position Wernicke agrees, although he formerly held that the ability to understand speech was, in

these cases, unimpaired. (*c*) The ability to write, if this was previously possessed, is lost simultaneously with the ability to articulate words. This is necessarily so if, as is maintained, the ability to write is, like the ability to pronounce words, connected with the unimpaired power of what the French call *la parole intérieure* (internal speech), a question to which I shall return after discussing the sensory type of aphasia.

Motor aphasia usually has an acute development connected with symptoms of apoplexy and more or less right-sided hemiplegia. The prognosis is more favorable than at one time it was thought to be, although Wernicke believes, against Déjérine and Thomas, that recoverable cases are those only in which a considerable power of speech remains outside the scope of the primary attack.

The outstanding feature of sensory aphasia is the loss of the ability to understand speech sounds. For an illustration of what exactly is involved in such a description, we may consider the processes by which a normal child learns his native tongue. It is agreed on all hands that the child acquires an understanding of spoken words, their meaning or denotation, a long time before his power to articulate them is developed. There is thus a certain independence of the sensory speech center in contrast to the more dependent motor center. But in regard to the sensory components of the speech mechanism, observation of the processes of acquiring the use of one's own or a foreign language requires that a distinction be drawn between two distinct though related functions, that, namely, by which word sounds as such are recognized, and that by which these sounds come to possess a distinct connotation. Thus, I may be perfectly familiar with the sound of the word *Gestalt*, but at the same time may have either no or only a very vague notion of the meaning that is attached to it by those for whom it denotes a particular tendency in modern psychology. Familiarity, that is to say, with the sounds of words, their recognition as word sounds, is no evidence that the meaning of the words is apprehended, or, in motor terms, that their denotation is correct. The problem of intelligent speech, apart from its

motor aspects, consists, therefore, in the ability to unite both these sensory functions in a single smoothly-working function, so that the word comes immediately to call up the sense, and the sense to call up the word. In intelligent speech, the auditory sound of the word is transfused with the meaning or the denotation of the word, and there thus comes to exist the condition that is described as 'the-understanding-of-the-word,' or, conversely, 'the-word-as-understood.' It is obvious that since spoken words are as conventionalized symbols as are their written forms, there is no congenital process on which language can rely, in the sense in which, for example, there are congenital structures for the fundamental instinctive activities. It, therefore, follows that the combination of word-sound and word-sense must be slowly acquired by practice. The necessity for emphasizing this feature of our problem is that psychologists have not sufficiently dwelt on the complexity of the sensory components of speech, and the behaviorists entirely ignore it; for just as the former have tended to resolve the complexity into the ability to recognize word-sounds, the latter have simplified the process further by identifying the whole problem of normal speech with the ability to articulate words.

There is no doubt that, while the general description of the process of acquiring intelligent speech is not greatly in dispute, the facts involved in the process and their relation to one another are more complex than would, at first sight, appear. The detailed study of speech disturbances has made this clear by confirming the general descriptive analysis, and by extending our knowledge of the mechanisms upon which in normal life phonetic speech depends. In this way, for example, there have come to be recognized distinct cortical areas for the sensory and motor components of speech. Investigation of each of these has shown that the former is more complex than the latter, which it conditions in important ways. Moreover, the sensory speech components are in an immediate relation to the vibrations of the air which act as appropriate stimuli for the auditory (VIII cranial) nerve; they are, therefore, functions of the environment in a sense

that is not true of the associated motor components. Further, hearing has been shown to be a faculty with a series of more or less differentiated functions, not all of which are concerned in speech. The normal ear, for example, is sensitive to sounds, tones, and words, and it has been experimentally shown that the range of vibration is in each case different. For sounds, the ear can distinguish vibrations which range from 15 to 40,000 per second; for tones, its discrimination is effective for vibrations which range from 40 to 4000 per second; for words, its sensitiveness is reduced to vibrations which range from 300 to 800 per second. To state the matter another way, while the normal ear can distinguish tones over more than 11 octaves, 7 of these being musically effective, word-sounds are discriminated over less than one-fourth this range, that is, over a tone span of less than two octaves.[9]

The facts to which attention has just been directed coupled with the investigations of speech disturbances from the clinical point of view justify the two following observations: first, that since sensory speech is a specialized form of tone-sensitivity, the quality of word-sounds might, as is sometimes done, be referred to by the term 'vocality,' the term 'tonality' being reserved for all ranges of the musical scale that have no verbal connections; and, second, that it is reasonable to suppose that the fibers of the cochlear division of the auditory nerve which are implicated in word sounds have their central termination in the limited area of

[9] Since the late nineties, a good deal of work has been done in this field both in the way of perfecting method and in the more careful determination of facts. For those who wish to carry the details further than I can possibly go in the text, I may mention E. H. Barton's 'Text-Book on Sound,' and D. C. Miller's 'Science of Musical Sounds.' Of the earlier work, I may refer to Bezold's article, 'Das Hörvermögen der Taubstummen und Nachträge dazu,' Wiesbaden, 1895–1896, *Zsch. f. Ohrenhk.*, 36, in which he has shown that the majority of the fibers of the auditory nerve are not involved in the comprehension of speech sounds, and that "in the entire musical scale there remains only the short distance from b′–g″ inclusive, therefore a large sixth, the perception of which is absolutely necessary for the understanding of speech"; and to H. Liepmann's 'Ein Fall von reiner Sprachtaubeheit,' Breslau, 1898, *Psychiat. Abhandl.*, Hefte 7–8, in which this writer maintains that a few tones above and below the limits marked out by Bezold, a range however amounting to less than two octaves, are involved in the understanding of speech.

the left temporal hemisphere that was assigned by Wernicke as the basis of sensory speech.

Before enumerating the symptoms of sensory aphasia one other point must be cleared up. It might seem to follow from what has been said that the loss of the ability to understand word-sounds should involve a loss of the ability to hear tones comprised within the range of the tone scale which underlies speech. This as we know is not invariably the case. The seeming anomaly is accounted for by the partial decussation of the fibers of the auditory nerve in the posterior field of the medulla oblongata, and the unilateral location of the area for sensory speech. While, therefore, in sensory aphasia the understanding of word sounds is abolished, the ability to hear the tonal quality of the word sounds is retained, the impulses from the latter being carried by the auditory tract that terminates in the right temporal hemisphere. Unilateral lesions, that is, result in word deafness and in a partial though not actual deafness for certain tones; in bilateral lesions, on the other hand, the sense for both sounds and words is abolished.

Clinically, sensory aphasia is characterized (*a*) by the impairment or absence of the ability to comprehend word-sounds, although no serious peripheral deafness is present. As, however, the comprehension of word-sounds, as distinct from word-tones, is essential for the comprehension of word-meaning, the latter is to some extent involved. (*b*) The ability to articulate words is retained, and the patient, to compensate for his sensory defects, may become very voluble. Articulate speech shows the lack of its normal sensory controls in the frequent use of incorrect and distorted words and phrases in naming objects and in the inability to imitate sounds. In spontaneous speech there is a tendency to confuse words to such an extent as to be unintelligible (jargon aphasia). (*c*) The ability to write, if this has been acquired, is lost, and is due, as in motor aphasia, to the impairment of the power of 'internal speech.'

The etiologic factor in the large majority of cases of sensory aphasia is the occlusion vessels. The onset is acute

and the symptoms usually are slight. With the progress of the disease, there is believed to be rapid compensation for the speech defect, new word pictures being gradually acquired. On the other hand Déjérine holds that the defect is permanent.

I must now say something about what the French call *la parole intérieure*. The term has sometimes been used as if it meant the sub-innervation of the vocal cords independently of the functioning of the other components of normal audible speech. This, however, is a mistake. The unanimity of those who have written on aphasia is remarkable on this point. It is quite clear that for them the phrase refers primarily not to the conative but to the cognitive factor of spoken language, and that the term 'intérieure' is used to indicate that the motor aspects of speech are subordinated and are sometimes suppressed. Thus, Baldwin's 'Dictionary,' in the article dealing with the subject, says that by internal speech is meant "the content when speech is mentally revived with or without actual utterance. . . . It indicates the class of mental states denoted popularly by the phrases having something to say 'in mind,' 'musing,' 'having tunes in one's head or ear' (internal song), together with the part played by such internal revivals in actual speech or song. . . . The adoption of Mercelli's term endophasia in English, French, and German is recommended, and with it the term endomusia is suggested for internal song (melody)." [10] This usage is indicated still more definitely when Wernicke equates the more general term with what he calls 'word conception.' Two other writers employ an almost equivalent terminology, Ziehen speaking of 'the concrete conception,' and Caro of the 'speech conception of words.' These descriptions point to the word's 'meaning' as the fundamental denotative use of the so-called 'internal speech,' and Déjérine understands it in the same way when he speaks of it as the *notion du mot* (the notion, concept, or meaning of the word).

[10] A discussion of the subject in English is contained in Bastian's 'The Brain as Organ of the Mind.' The two following works are concerned directly with the subject: Ballet, 'La Parole Intérieure,' and Séglas, 'Les Troubles du Langage chez les Aliénés.'

Studies of aphasia have required a distinction to be made between what Liepmann calls 'the understanding of word-sounds' and the comprehension of the meaning that such sounds have. The cortical center for the former, it is agreed, is Wernicke's area in the first and second convolution of the left temporal lobe. It remains to consider what anatomical basis has been postulated for the understanding of the word-sense. That we cannot speak of a 'conception center,' in the sense that we speak of a sensory and motor center for speech, is agreed on all hands. What we find is that the anatomical findings correspond closely with the psychological fact, namely, that the perception of objects is not a single but a complex process in which a number of sense fields is involved. To meet very special, let us say laboratory, conditions of experience, we may postulate a separate 'memory picture' for each of the senses and in that way an unambiguous denotation would attach to our common ways of speaking of a visual, an auditory, a tactile, an olfactory, etc., picture of the object. But in actual life, in the hurly-burly and rush of everyday experience, this condition is never realized by the normal individual.[11] What the 'perception of an object' really amounts to is that, by the constant repetition of the same impressions of special sense, a firm association of these theoretically separate pictures is formed, so that the stimulation of any one sense by the object is sufficient to remind us, in some manner and measure, of the sum of its characteristic properties. There is naturally considerable variation in the complexity of our different perceptions, but, in every case, it is the definite and firm grouping of the properties of the object that is the basis of conception. Thus, the understanding of the sense of a word and the understanding of the word are not, psychologically, equally simple facts, and this is also mirrored in the neurological substratum. For example, they are the different projection fields at the cortex that are pointed to as the morphological bases of the visual, tactual, auditory, etc., memory pictures (images) which, when asso-

[11] See my article on 'Mechanism, Meaning and Teleology in Behavior,' *Amer. J. Psychol.*, 1926, 31, pp. 14*f*.

ciated, give us psychologically the 'word conception.' In order that the associated group of images, which is the psychological equivalent of the object to which the word refers, may 'enter into consciousness,' it is necessary that the word-sound should both be apprehended and understood. That is to say, the projection fields of the special senses and the center for word-sounds must be connected by an association tract which will then be regarded as the anatomical basis of intelligent speech. A similar connection between the projection fields and the center for the articulation of words must also be postulated, if the various types of clinical aphasia, sensory and motor, are to be accounted for. The tracts in both these instances have been called by Wernicke 'transcortical,' and their termination is traced to the island of Reil with its claustrum; a conclusion which agrees with the view of Meynert that these structures are definitely an association organ.

With these facts before us, it is easily seen, not only that normal speech is a more complicated affair than at first sight appears, involving, as it does, the integrity and the associated functioning of all the parts of the mechanism of speech, but that, according as one or other of the main structures and its connections which underlie normal speech is interfered with, different forms of aphasia, sensory and motor, will result. The limits of my subject require only that I should refer to one special point in this connection. Since the projection fields converge in both Wernicke's and Broca's areas, we must suppose that the 'word conception' contains both a sensory and a motor constituent, and that it determines not only the sensory picture of objects but also the correct conceptions of word-movement. In that case, the process of learning a language and its employment in new situations, in distinction from the repetition of words and sentences that have previously been learned, necessitate the intactness and normal functioning of the sensory speech centers, if the motor mechanism is to be brought normally into play.

IV

I mentioned above that it is sometimes difficult to know, with the necessary degree of certainty, what behaviorism means specifically by speech reactions, and particularly upon what individual mechanism the speech reactions depend. In the passage quoted from Watson at the beginning, most of the phenomena of implicit behavior (speech reactions) are said to have their seat in the larynx. This has been accepted generally as the orthodox position since the publication of 'Behavior' (1914). Our ordinary uncritical human haste to have some basis on which to proceed, some *ποῦ στω* from which to push off into the untried seas, may account for the failure to appraise the effect of modifying paragraphs in the first formulation of the doctrine. For instance, in discussing the work of Anna Wyczoikowski on the speech mechanisms —which incidentally has the merit of supplying us with 'curves' showing the movements involved in 'thinking' and 'hearing' verbal and musical sounds, however subject to improvement her method of collecting and interpreting her data may be,—we are told that there are forms of language that are not laryngeal. "In the section below," Watson writes, "we shall see that there are forms of language habits other than those appearing in the vocal apparatus. For this reason it is clear that robbing a man of the laryngeal mechanism would not rob him of thought (speech reaction) since usually in those cases in which a man has been robbed of this apparatus there has been a tumorous or cancerous growth that has been slow in its onset, and for this reason *bodily language* habits have grown up. Furthermore, even in cocainizing the vocal apparatus, we do not destroy the possibility of throat and laryngeal movement. Only the sensory nerve endings in the mucous membranes will be touched by the cocaine. The deep-lying sensory endings of the muscles which are the only essential (sensory) ones from our point of view, will not be affected by the cocaine. If we could find a case where a man suddenly lost his laryngeal apparatus without any serious injury to the other bodily mechanisms, we should have a crucial case. From our point

of view there would be, or ought to be, a serious limitation in this man's thought processes." [12] Watson's position in this book, therefore, seems to be that language habits are (*a*) mainly laryngeal, that is, contractions of the vocal cords, and (*b*), less conspicuously, 'bodily language habits' which, as we shall see later, are identified with the learned movements of arms, hands, legs, etc.

In his 'Psychology,[13] published five years after 'Behavior,' Watson deals with the same topics. In the sections that discuss the subject, there is a noticeable change in emphasis if not a radical difference of doctrine. "From our standpoint," says Watson, "it is not necessary to assume that all thought is laryngeal even if we use 'laryngeal' to include the whole mechanism described on p. 334," that is, the oral, nasal, and laryngeal parts of the pharynx. The basis of this statement is the distinction that is drawn between vocal and language habits, the former consisting of "the mere sounding of words of the non-instinctive type," [14] which are learned very much as a parrot learns to utter word sounds. Vocal acts pass over into language when "they become associated with arm, hand and leg activities and substitutable for them." [15] The emphasis here is obviously upon the 'bodily language habits' of the earlier statement. Not only is this the case in discussing the early acquisition of language habits; the subordination of the vocal cord mechanism is carried further when he considers what behaviorism means by 'articulate language.' The case is supposed where the larynx has been removed, and, therefore, the ability to speak aloud has been abolished. The position is maintained that "so long as the air can pass from the lungs to the pharynx and mouth, faint whispered speech is possible. When the air passage is entirely closed between the lungs and mouth,

[12] 'Behavior,' p. 327.

[13] The first edition of the 'Psychology' was published in 1919. I regret that I have before me only the second edition (1924), and am unable to check the passages quoted in the text with the corresponding passages in the first edition. My impression, however, is that there is no substantial difference in doctrine in the two editions.

[14] *Op. cit.*, p. 339.

[15] *Op. cit.*, p. 340.

as happens when the windpipe is opened below the larynx and the patient has to breathe through an opening in the neck (tracheal cannula), all articulate speech even of the *sotto voce* type disappears. But such individuals can and do still make all the movements necessary for articulate speech." [16] Language, on this view, is identified with the sounds made by the passage of the air from the lungs through the pharynx and mouth, a doctrine that is far away from the theory of the earlier statement that articulate speech depended upon the sub-innervation of the vocal cords.

In two important articles,[17] published more recently, Watson reverts to the subject, and from the title of the second, and the text of both, we are led to infer that the bucco-pharyngeal theory of speech in the 'Psychology' has been laid aside for the vocal-cord theory in the 'Behavior.' Nowhere, however, do we find the former view repudiated, and perhaps it is possible to regard them as separate parts of a more comprehensive doctrine. However that may be, and so far as our present interest is concerned, the theories I have mentioned, either singly or in combination, postulate the exclusively peripheral nature of our vocal and language habits, that is to say, generally, of the unsorted mass of implicit behavior that behaviorism classifies under the term 'speech-reactions.' It is, however, obvious that until the position is stated in a less ambiguous form, there will always remain a doubt as to what the mechanism is upon which particular speech-reactions depend.[18]

[16] *Op. cit.*, p. 337. This passage continues: "This is the answer to the criticisms which have been directed against the point of view . . . that thought is the action of language mechanisms."

[17] 'The Unverbalized in Human Behavior,' PSYCHOL. REV., 1924, 31, pp. 273–280; and 'The Place of Kinæsthetic, Visceral and Laryngeal Organization in Thinking,' PSYCHOL. REV., 1924, 31, pp. 339–347.

[18] In the articles referred to above, Watson adverts to a subject which has a connection with the present discussion and which helps to place the view of behaviorism more strongly before us. In 'The Place of Kinæsthetic, Visceral and Laryngeal Organization in Thinking,' he remarks that "Psychologists before the advent of the behaviorist neglected to point out the significance of word organization," and in 'The Unverbalized in Human Behavior' he writes: "It is believed that when subjective psychologists have given verbalization its due place in the whole process of bodily organization they will be ready to admit that being 'conscious' is merely a popular

The motor peripheral theory of language of behaviorism, as outlined above, gives altogether too simple an account of the complexity of speech, and of the associated mechanisms

or literary phrase descriptive of the act of *naming our universe of objects both inside and outside*, and that 'introspecting' is a much narrower popular phrase descriptive of the more awkward act of *naming tissue changes that are taking place, i.e.*, movements of muscles, tendons, glandular secretions, respiration, circulation and the like. In other words, neither of them has any existence as a psychological process." I regret my inability to discuss the subject of these passages, an inability that rests primarily upon my failure to understand exactly what it is that is said in them. However, before behaviorism, if my recollection serves me, the psychologists did 'point out' the place of word organization in their science, and were severely criticized for so doing on the ground that they were writing 'logic' and not 'psychology'; and, of course, the origin of language has given rise to much psychological discussion among those who interested themselves in the subject of primitive culture, and it has been extensively considered in the books, for example Wundt's, on folk psychology. Surely Watson cannot be making so pointless a remark that 'before the advent of the behaviorist' the psychologists did not at that time say what now the behaviorists are saying about 'the significance of word organization.'

My chief difficulty, however, is with the second quotation, for I really do not know what is meant by defining 'being conscious' as the 'act of naming our universe of objects inside and outside.' I do not mean that I disagree with this statement as a definition of 'being conscious,' but that the definition itself does not convey to me any intelligible idea. I could understand, even though I disagreed with, the statement that 'being conscious' is equivalent to 'the act of naming,' irrespective of what it is that is named. I do not understand what 'our universe of objects inside and outside,' as the object of this naming, denotes. And when 'the act of naming' is the naming of 'our universe of objects inside and outside,' which is all we were given at the outset, I confess I am all at sea. No comment is needed on the definition of 'introspection' as 'the act of naming tissue changes that are taking place,' since, according to behaviorism of the type under consideration, there is nothing within the organism but 'tissue changes,' and, consequently, if anything is named it must be these. But, in that case, one may be pardoned for wondering what 'the act of naming,' in any instance, is, if it also is not a tissue change. All, therefore, that the statement amounts to is that it calls attention to the fact of tissue changes going on within the organism. I can hardly think that this is what Watson intended to say. What may have been meant is that the changes going on in one tissue, namely, in the throat, stand in the relation called 'the act of naming' to the changes that are taking place in all the other tissues. The difficulty, however, with that is that some other 'tissue change' would be required to perform for it 'the act of naming' which it had already performed for the others, and there does not seem to be any that is free to do this since all the others are neatly tucked away in the one series to which all the changes in question belong. But if this difficulty were overcome, would it not be at the risk of instituting an infinite regress, so that the changes that are 'the act of naming' could themselves never be named because they could never name themselves but would need another to render this service, and this another, and so on *ad infinitum*. The only alternative I can think of is that each change performs 'the act of naming' for every preceding one, a doctrine that is highly reminiscent of James' well-known principle of the passing

through which speech, in the form of both verbal and language habits, takes place normally in the human individual. After a review of the anatomical and physiological facts involved in speech, it seems almost incredible that anyone should formulate the bucco-pharyngeal or laryngeal view, or that, when formulated, any one should be so credulous as to give it serious attention. These are mysteries however that do not concern us greatly. As there is a measure of good in things evil, so it would seem a small amount of manageable truth may be mixed without detriment in a peck of error. For, of course, that speech emerges out of the mouth by means of muscles that mechanically contract is a fact that has been known ever since Eve, according to the man's report, tempted Adam in the garden of Eden. Speech certainly is a peripheral phenomenon, even if that is not all it is. No one, I think, has a quarrel with behaviorism for keeping this fact clearly and persistently before us. And since behaviorism, as it tells us, is a study of the peripheral contacts of the living organism with, and its reactions to, its environment, it is committed from the start to study language, as it does all behavior whatever, as a relation of adjustment between the individual and his particular determining con-

thought being the thinker translated into physical terms. But would that do more than get rid of a logical difficulty? The trouble really is with this mysterious 'act of naming' itself. And this goes back, in part, to the ambiguities of the theory of language, and the difficulty of seeing how 'air passing from the lungs through the pharynx and mouth, or through the vocal cords' can *be* 'the act of naming' muscular and glandular changes in other parts of the body, and, in part, to the fact that 'naming' was an important stage in the development of thought according to the older psychologists, for example, Sully. To denote the throat contractions by such a term as 'naming,' therefore, is very confusing, and moreover it is just as objectionable as 'introspection' for which it is offered as a substitute. In both, there is implied a relation between the organism and the changes of the organism that is not open to the observation of any one indifferently, but only to the individual organism in question, for only the organism could tell if particular throat contractions were or were not 'the act of naming' movements of muscles, glands, etc., since some obviously might not be. To sum up then, I should say it is fairly obvious that, as so often happens when we run down the details of behaviorism to their historic antecedents, we have in this instance an example of the unconscious introduction under disguised form of repudiated psychological conceptions, 'awareness' for example, and the surreptitious reintroduction of the discarded 'introspection' under the term 'the act of naming,' and with it the world of the conscious to which introspection is alone relevant.

ditions. It is, therefore, not as a description of certain obvious and, consequently, insufficiently noted facts that the speech reactions are here brought into question. I might go further and say that there is no special objection against the method of telescoping all that lies back of the 'muscle twitches' of the throat in the central nervous system, and substituting therefor a simple formula of a mathematico-physical sort, as is done, for example, by Weiss when he speaks of electron-proton aggregates of different degrees of complexity. There is no objection to this procedure so long as we treat these hypothetical entities as interpolated unknowns, as representatives of data which possibly have no closer resemblance to the facts they represent than the mathematician's x has, in a particular instance, to 'the value of x' in the final solution of his problem. In a strict interpretation, there is no more reason why the behaviorist should concern himself with the details of the nervous mechanisms of speech than why the butcher or baker should concern himself with those parts of the digestive mechanism which lie beyond the taste-buds of the tongue, palate, and pharynx. Speaking, like eating, is a bucco-pharyngeal phenomenon, and what more is there to be said about it?

The attitude of behaviorism of the type in question toward the anatomical relations and physiological functions of the nervous system as a whole is suggested in the foregoing paragraph. Behaviorism is an attempt to explain our overt and implicit habits without having recourse to the structures that are located in the brain and spinal cord. For that reason, it is difficult to understand the point of the criticism that has sometimes been made that behaviorism is not a psychological movement but a special branch of physiology. I am glad to find myself in agreement with Watson at this point. He has gone a long way in making it clear that the conditions of modern social and industrial life require the subordination of our interests in physics, chemistry, physiology, and medicine, and the concentration of them on a study of psychology in the modern sense of the term. He even goes so far as to advise the non-technical student to

omit the chapters in his 'Psychology' which deal with "the nervous system, muscles and glands," an omission, he says, which "will in no way interfere with an understanding of the behaviorist's point of view." This is very much to the good in clearing our notion of behaviorism of unnecessary obscurity, and giving it, along with other modern developments, its proper place in any attempt to show that psychology has not only lengthened its course but broadened its banks in the past thirty-five years.

The mechanisms which, in the normal subject, are concerned in language may, for the purposes of description, be said to be two, the sensory and the motor, and each of these may be subdivided into a peripheral, a subcortical, and a cortical section. Further, the sensory and motor divisions are connected at their central ends by association tracts which not only complete the anatomical structure that subserves the purpose of speech, but maintain the physiological unity of the mechanisms as a whole.

The peripheral portions of the sensory and motor mechanisms are both related to the vibrations of air, which are the appropriate stimuli for hearing sounds, tones, and words, the former in the way of receiving, the latter in the way of producing such stimuli. The motor peripheral structures have been mentioned in our presentation of the language theory of behaviorism, and comprise the pharynx, the larynx, and the mouth. By the contraction of the muscles attached to these parts, as the air passes from the lungs, speech sounds are made. The structures by which sound stimuli are received are the external ear or pinna; the middle ear, separated from the former by the tympanum, consisting of a series of ossicles, the malleus, the incus, and the stapes, together with their muscles, the tensor tympani and the stapedius; the inner ear, located in the temporal bone, and consisting of the semicircular canals and the shell-like structure called the cochlea, the latter, however, alone being implicated in the function of hearing.

The subcortical connections of the peripheral sensory portion of the auditory mechanism include (*a*) the cochlear

division of the auditory (VIII cranial) nerve, which takes its origin in the bipolar cells of the spiral ganglion situated in the cochlea. Its fibers pass at different levels into the central canal (modiolus) of the cochlea and emerge at the base in well defined bundles. Here it divides into a peripheral and a central branch, the former being distributed to the organ of Corti, and the latter terminating in the ventral and dorsal nuclei located on the restiform body in the caudal portion of the fourth ventricle; (*b*) neurones which have their origin in the ventral and dorsal nuclei just mentioned and which, after crossing the median plane, pursue a central course under the name of the lateral lemniscus. The point of termination for some of the fibers is the inferior corpora quadrigemina, and for the others the median geniculate body. The inferior corpora quadrigemina serve as a center for reflexes in response to sound, and the median geniculate body is a way-station on the auditory path to the cerebral cortex; (*c*) fibers which have their origin in cells in the median geniculate body, and which constitute the auditory radiation. These pass through the internal capsule of the corpora striata and terminate in the auditory center in the cerebral cortex.

The cortical portion of the sensory speech mechanism is, as we have seen above, Wernicke's area in the temporal lobe of the left hemisphere for right-handed persons, and in the temporal lobe of the right hemisphere for left-handed persons.

The subcortical structures for motor speech conform to the general pattern of all other motor activities of the organism, and comprise two sets of neurones, one of which has its origin in the large multipolar cells of the somatic motor nuclei in the brain stem and terminate in the muscles of the speech organs; the other having its origin in the pyramidal or Betz cells of the fifth layer of the cerebral cortex and terminate by a process of arborization around the cells from which the first set of neurones arise. There is thus a continuous path for the motor impulses from the motor center in the cortex to the motor nuclei and from thence through the lower motor neurones to the muscles of the peripheral speech organs.

The cortical portion of the motor speech mechanism is located in the first temporal convolution of the left hemisphere in what is known as Broca's area.

The mechanisms for motor and sensory speech, which have just been described, as those for all other sensory and motor functions of the organism, are connected with each other, and with the outlying portions of the brain by means of a complicated system of association fibers and tracts, the centers for which are scattered throughout the cortex in the areas intermediate between those parts of the cortex which have taken on special sensory or motor functions. It is not necessary to specify, more particularly than has been done above, the special connections between the centers for hearing and speaking words; it is sufficient, for our purpose, if it is remembered (*a*) that neither the sensory nor the motor speech center functions normally as an independent mechanism; (*b*) that any defect in the mechanism of the one involves some impairment in the function of the other; (*c*) that in both sensory and motor speech other motor and sensory functions are involved than those which depend upon these more specialized mechanisms.[19] The general fact to which these remarks point is that from the anatomical and physiological standpoints the function of speech, as of all other specialized functions, involves the activity of the whole brain, and that such a unified and correlated activity of the brain is made possible by, and is directly dependent upon

[19] The dependence of the motor upon the sensory components of behavior even at the reflex level is nicely seen in the disturbances of the motor adjustments of patients suffering from tabes dorsalis (locomotor ataxia). In this disease, the long uncrossed branches of the dorsal (sensory) root fibers of the cord are involved, and the proprioceptive functions of muscular sensibility and the recognition of posture are impaired. The diminution or absence of sensations of this variety removes the normal controls of the motor mechanisms which are thereby rendered ineffective. Thus, standing with the heel and toes of his feet together, and with eyes closed, the patient loses his balance and sways from side to side (Romberg's sign), and on walking there is uncertainty and poor coördination of the movements of his limbs (ataxic gait). If the behaviorists are right in their contention that the sensory factors are neutral for behavior, these patients ought not to show any motor disturbances, since in this disease it is only the sensory components that are involved.

the development after birth of the systems of associative connections to which reference has been made.[20]

If I have succeeded in enabling the reader to form a picture of the interconnections and interdependencies of the various parts of the mechanisms on which instinctive and non-instinctive, non-significant and significant, vocal sounds depend, it will be obvious in what respects behaviorism fails to take account of the complexities of the situation as it actually exists. Let it not, however, be thought that the behaviorist's contribution to the discussion of language is throughout false. It contains much that seems to me true, and even where I think it errs, the method of presentation is arresting and provokes thought. No particular objection, for instance, can be brought against its descriptive classification of the various stages of the so-called 'speech-reactions.' According to Watson, speech-reactions are of two main kinds, vocal sounds and language, and each of these is shown to be capable of further subdivision. Vocal sounds, laryngeal and bucco-pharyngeal, are either native, those, namely, which consist of the primitive sounds that are characteristic of the human or animal species, and are presumed to have an instinctive basis; or acquired, that is, word-sounds that are learned from the speech that is spoken in the child's hearing,

[20] S. W. Ranson ('The Anatomy of the Nervous System,' p. 55), speaking of the anatomical connections upon which behavior depends, says: "For an incoming impulse a variety of paths are open, one or more of which may be taken according to the momentary resistance of each. There is reason to believe that the resistance to conduction across a synapse may vary from moment to moment, according to the physiologic state of the neurons involved. It is therefore not necessary that every impulse entering by a given fiber shall travel the same path within the central nervous system nor produce the same result. The pathways themselves are, however, more or less fixed, and depend upon the structural relations established among the neurons. Many of these synaptic connections are formed before birth, follow an hereditary pattern, and are approximately the same for each individual of the species. . . . In man, and to a less extent in other mammals, the nervous system continues to develop long after birth. This postnatal development is influenced by the experience of the individual and is more or less individual in pattern. It is probable 'that in certain parts of the nervous mechanism new connections can always be established through education' (Edinger, 1911). The neurons which make up the nervous system of an adult man are therefore arranged in a system the larger outlines of which follow an hereditary pattern, but many of the details of which have been shaped by the experience of the individual."

and which are, therefore, said to be non-instinctive or imitative in their origin. Language, likewise, takes on two forms, an undeveloped and a developed. The former is unverbalized and consists of various bodily movements of a primitive kind, including gestures, the grimaces, the clenchings of the fists, etc., in which the child expresses his attitude toward persons and things; the latter is verbalized and consists in the association of word sounds with learned bodily habits, and, at a later stage, in the substitution of the word-sounds for the bodily habits. In adult language, Watson points out, in the later article mentioned above, that the total motor organization is brought into play, so that we may be said to speak, or, as he says, 'think,' with the whole body. It is perhaps owing to the facts underlying such a view that language, in its developed forms, is so refined and flexible an instrument for the expression of the complex relations which are established and maintained by the human species with the physico-social world about him.

When, however, we ask for an explanation of how the several steps in the development of language are to be accounted for, we find that they are all referred by behaviorism to the reflex type of action. That some of the steps are of this character there is no reason to deny. The vocal sounds that are primitively characteristic of the human and animal infant, and some of the bodily habits, may be said to belong here, the accidents of the environment, internal and external to the individual, serving to set off a mechanism which is congenitally fitted for that type of reaction. But is the situation present in the case, for example, of the acquired vocal sounds, and of the more advanced stages of language development, of exactly the same nature? Acquired vocal sounds were described, in contrast to those that are native, as non-instinctive, and Watson struggles with the question of the relation of imitation to them. In his discussion of this subject, he states, within the limits of ten lines, a view that would seem to be self-contradictory. He says, first, that "Imitation seems to be a process directly connected with the establishment of the act," and, second, that "the

imitation here may be more apparent than real." Another statement of the problem is given in terms of what it is that gives the set to the motor mechanism in the acquisition of new word-sounds, and it is there indicated that the answer must be found in the word-sounds which are spoken in the child's hearing. But this also will not do, and in the space of two lines Watson repeats the same inconsistencies in new terms when he affirms, first, that the constant repetition of sounds by the parent in the hearing of the child can serve only as "a stimulus for that which the infant's vocal mechanisms are just set to utter," and, second, that "whether the parent's words can set the mechanism is doubtful." [21] It is certainly not very clear what the behaviorist would have us believe is the truth of the matter.

The reason why we are not brought nearer to a clear statement, it would seem, is that acquired vocal sounds and with them developed language are being laid on the Procrustean bed of reflex action, and whatever is more than this has to be cut away that the theory of behaviorism may not suffer damage from the refractory nature of the facts. I do not mean that this is done with a clear intention, and, therefore, I hasten to say that if all the implications of reflexes were kept in mind the difficulty would vanish, but only to break out in another place and in another form. For reflexes are not, as some of the above statements would seem to suggest, self-acting mechanisms; they depend, on the contrary, upon the operation of stimuli which by their nature are fitted to start the series of activities which eventuate in the observed behavior. It is this fact of dependence on stimuli external to the mechanisms in question that the behaviorist finds it so difficult to recognize. I have pointed out elsewhere [22] that when he reduces the objective continuum, the source of the stimuli for reflex actions, to the proton-electron aggregate which constitutes the particular individual, Weiss falls into a definitely solipsistic position, and the same criticism applies to Watson's hesitances about

[21] 'Psychology,' p. 340.

[22] 'Mechanism, Meaning and Teleology in Behavior,' *Amer. J. Psychol.*, 1926, 37, p. 10.

the efficacy of stimuli to give the set to the mechanisms of the speech reactions. What he holds, or wishes to hold, is that the mechanisms set themselves, and is not this equivalent to saying that word-sounds, acquired as well as native, are innate, and wait only on the unfolding of time to provide the occasion for their utterance? How little has the behaviorist freed himself from the Cartesianism with which behaviorism in its origin is thought to be a complete break!

The fact then seems to be that acquired speech reproduces heard sounds which act as stimuli to congenital mechanisms which more or less perfectly imitate them. One would, indeed, infer as much from the reference that Watson makes to the work of Conradi who, he says in a footnote, has shown that 'the cries and songs of young birds brought up by adults of a different species are greatly modified.' In developed speech also there are other factors present, since here we are not confined to the imitation but to the creation of significant speech, and among these factors must be included the complicated structures on which, it was pointed out above, the word-sense depends. It would, therefore, seem that we are not only stating the obvious, but what is, at the same time, justified by the scientific study of the anatomy and physiology of the speech mechanisms, if we say that the intended meaning is part of the determiner of the language forms which are the media of the social interchange of ideas.

I have never been able to escape the feeling that the behaviorist's custom of speaking of vocal sounds and language, and, indeed, of all the developed side of human life, as habits, obscures the problem of the origin of these and the other forms of behavior, and that this is detrimental to an appreciation of the scientific value of behaviorism. By habit, of course, we mean a repeatable form of activity, and about such the real question is how the activity in the first place came to be formed. If behaviorism has considered this last question at all it is in connection with the instinctive vocal sounds. With reference to the higher stages of language, we have been asked to be satisfied with the application to them of what has been shown to be the fact in the lower

instinctive stages. A logical inference of this sort from one set of facts to another can only be justified, in science or elsewhere, if we are sure that there is no essential difference between the sets of fact in question, and I do not know where behaviorism has provided the basis necessary for such a belief. On the other hand, Watson, as we have seen, clearly recognizes and asserts that in its higher stages human language, including the association and substitution of word sounds with and for bodily habits, is beyond the capabilities of the animal species. Does this not constitute an essential difference and are we not justified in asking for some more adequate account of the fact?

There is another confusion which behaviorism carries over from its general position to its treatment of language. I mean, that not a sufficiently clear distinction is made between the mechanical nature of the structures which subserve behavior and the psychological nature of the behavior which the structures subserve. It may be admitted that the whole physico-chemical structure of life is mechanically functional, but are we thereby committed to the position that the product of the machinery is of the same nature? The impression is sometimes made that behaviorism wishes to defend the view that behavior is part of the machine by which it is produced. This has led to its failure to deal adequately, as was pointed out above, with the stimuli of speech reactions. It likewise leads it to underestimate or ignore the complexity of the interconnections of the mechanisms of the speech sounds. An example of this over-simplification is found in the stimulus-response formula which appears so often in the literature. The response is, of course, the behavior, but the stimulus, as I have shown, is in an ambiguous position. Literally considered, the stimulus would be whatever it is that acted as a cause in setting the mechanisms in operation which produced the response. The antecedent conditions of speech, as indeed of all behavior, can be found only in the nervous system, and not in the environment by which the mechanisms in question are stimulated to function in ways that are characteristic of them. The

formula however does not say this; it does not mean this. In speaking, for example, about the early type of emotional reactions Watson says that there is "nothing in them which is not fully statable in terms of situation and response," and his analysis of fear bears out the supposition that the response is the immediate effect of the stimulus. This is hardly true anywhere, and the clinical study of speech shows that it is not true of language. When however behaviorism is forced back upon the nervous system it refuses to take it in its complexity, and concentrates attention on the innervation of the muscles and glands. Ignoring the fact that the motor and the sensory parts of the system act together from the lowest level of reflex action up to the complicated interactions that underlie speech, it separates the sensory components from the motor components of the speech mechanisms.

VERBALIZATION IN MULTIPLE CHOICE REACTIONS

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While investigating the effect of electric shock administered for inaccuracy in continuous multiple choice reactions,[1] the writer found that practically all subjects verbalized each stimulus and response. For one of the codes the verbal response to the red signal might be 'red-thumb,' 'red-outside,' 'red-one,' 'red-left.' Starting with a totally unfamiliar code, the subject named each color as it was presented, pressed one key after another until the correct one was found, and then named this key or its corresponding finger. When the signal reoccurred, the complete verbal response was given before any finger response was made. In other words the code was memorized verbally, and the propioceptive stimulation from this verbalization determined which finger should be used. After prolonged practice, however, the signal directly or substitutively set off the finger response, *i.e.*, without the intermediation of the verbal response, although the verbal response or at least the naming of the stimulus persisted.

A knowledge of these facts made the explanation of various types of error and the major effect of punishment readily explainable. Those subjects who designated the keys for the thumb and little finger as 'outside,' the one for the middle as 'middle,' and the other two indefinitely, made numerous mistakes by using the thumb instead of the little finger and vice versa, and by using the forefinger instead of the third finger and vice versa. Another type of error that was rather common was the pressing of the key for blue when green was shown or the pressing of the key for green when blue was shown. The green and blue were quite readily

[1] *J. Exper. Psychol.*, 1926, 9, pp. 1–18.

distinguishable, but it is not uncommon to find individuals who call both green and blue indiscriminately either green or blue. This verbal habit was later revealed by requiring the individuals to name the colors as presented.

Other errors were made in which the incorrect response was given so quickly after the last correct response that the experimenter suspected that the subjects were anticipating the colors. Upon being questioned, they agreed that this was the case and also reported that the anticipation was a *thinking* of, or, if behavioristically trained, a *sub-vocal naming* of some one of the colors. To verify this report, three individuals were employed in a special experiment. As soon as an error of this type was noticed, the apparatus was immediately stopped and the subject asked to name the last color of which he had thought. In 20 cases out of 34 the color given by the subject corresponded to the key on which the error was made, although this color had, of course, not been shown.

Another form of error which occurred frequently seemed so peculiar before explained that the experimenter spent a great deal of time making certain that the apparatus was not at fault. The error consisted in closing a particular key a second time, the second pressure coming after the next signal was in view. For example, if red was shown, a thumb response was made, and the next signal of a different color followed, but the thumb response was repeated. Quite obviously the subject 'knew' that this key could not be correct for the new signal. This type of error came only after prolonged practice with a particular code, and this fact considered in connection with the fact that the naming of the colors persisted, suggested the explanation. The first response was the automatic response to the signal, the second was set off by the implicit naming of the color, this naming in earlier practice having preceded the finger response, but now coming practically simultaneously with the first finger response.

These types of error, all of which result from peculiarities of the verbal responses made by the subjects, together with

the errors resulting from the subject's inability to respond solely with a single finger, account for practically all the errors made. The effects of punishment are likewise connected with these verbal responses, as will now be shown.

Practically all subjects made their verbal responses explicitly until the code became fairly familiar, but more important is the fact that punishment tended to delay the transition to the automatic non-verbally directed response. Since all subjects were working for speed as well as for accuracy, the transition was made before the direct finger responses were sufficiently established to be accurate. This loss of accuracy was compensated by increased speed in the case of unpunished individuals, while for the punished it resulted in numerous shocks which set up a tendency toward key avoidance. The finger response was thus delayed, as before, until set off, or at least reinforced from the verbal response. This is a stimulus-response explanation of what is ordinarily termed 'being more careful.'

These explanations are all in accordance with Watson's conception of the word as a stimulus.[2] In order further to verify them and thereby increase the experimental evidence in support of the behavioristic view of verbal responses, the writer made the investigation which will now be described.

The particular problem was to secure a technique in which it could be shown as conclusively as possible that the word, particularly the sub-vocal word, is the stimulus for some overt behavior. One possibility was to have the subject pronounce some word simultaneously with the presentation of an adequate stimulus for an 'involuntary' response and to do this so often that the pronouncing of the word aloud or sub-vocally would set off the response as in any case of the conditioned response. The writer expects to use this procedure in later experimentation.

However, by using the continuous multiple choice reaction apparatus [3] with easily secured modifications, another method was planned which adequately meets the demands of the

[2] Watson, J. B., 'Psychology from the Standpoint of a Behaviorist,' pp. 331*ff*.
[3] *J. Exper. Psychol.*, 1925, 8, pp. 325–336.

problem. In brief, the procedure was to make certain that a visual word would set off a sub-vocal response, have the subject repeatedly make a finger response to the presence of the stimulus of which the word was the name, and then to present the visual word to determine whether the finger response was set off by this stimulus which had itself never preceded this response.

The apparatus as here used allowed four operating conditions by throwing the proper switches.

(1) Four colors—red, green, yellow, and blue—were presented in random succession each for 1½ seconds, the green appearing twice as often as any other.

(2) Same as 1, except that the printed word 'green' replaced the color green one half the time.

(3) Same as 1, except that the color green remained until the subject made an almost complete flexion of his middle finger which was the only finger free to move, the arm having been harnessed into the arm rest of the ergograph, and except that the other colors remained but one second.

(4) Same as 3, except that the word 'green' appeared in the same way as in 2.

Recording was done on one of the laboratory continuous recorders.[4] One marker indicated finger flexion, being mechanically operated from the finger. The other marker was magnetically operated. The magnet was activated when the color green was in view and when a flexion was made at any time other than when the color green or the word green was shown. From these two lines, the reaction time to green, the errors made, and the presence of a flexion to the word green could be read.

Procedure.—After some preliminary work the following procedure was adopted:

Part *A*. The subject was given these instructions: "On the ground glass four colors—red, green, blue, and yellow will appear, each remaining for one and one half seconds. You are to call out the color of the ground glass as quickly as

[4] Renshaw, S., and Weiss, A. P., 'Apparatus for Recording Changes in Bodily Posture,' *Amer. J. Psychol.*, 1926, 37, pp. 266-267.

possible and loudly enough that I can hear you distinctly." The apparatus was started under condition 1, and allowed to continue from one to two minutes when it was switched to condition 2 (presenting the word green). The apparatus was stopped as soon as the word green had appeared once.

Part *B*. Since in part *A* the subjects invariably called out 'green' in response to the word green it was now emphasized that his instructions were to call out the *color* of the ground glass. After the experimenter was certain that the subject understood that he was to call out *only* the *colors*, he was told to continue as before. After allowing the subject to call out colors from three to five minutes, the apparatus was again switched to condition 2 and as soon as the word green appeared the apparatus was stopped.

Part *C*. The subject's arm was then placed in the arm rest, and the string which controlled the apparatus key and the recording marker was fastened to the middle finger. He was instructed to pay no attention to anything except the *color* green and to respond to it by pulling the string as quickly as possible. The apparatus was run from five to seven minutes under condition 3 and then switched to condition 4 until the word green had appeared twice and was then switched back to condition 3.

Part *D*. With the apparatus still running from Part *C*, a switch was thrown so that in a short time no signal would appear, at which time the experimenter called out the word 'green' as quickly as possible. The switch was then thrown back for about one-half minute when again it was opened and the word 'green' again called out. This completed the regular procedure for any subject.

Results.—Fifty individuals from the sections in Elementary Psychology were used. The number who responded to the word 'green' in the same manner as to the color green were as follows: Part *A*—50, Part *B*—43, Part *C*—43, and Part *D*—19. When the individuals are so grouped that all who gave the same results in all parts are grouped together, there are four groups. The number of individuals in each group and the nature of the responses made to the word 'green' in each part are shown in Table 1.

TABLE I.

Group	Number in group	Part *A*	Part *B*	Part *C*	Part *D*
1	17	Green	Green	Flexion	Flexion
2	26	Green	Green	Flexion	No flexion
3	5	Green	Yellow	No flexion	No flexion
4	2	Green	Yellow	No flexion	Flexion

Part *A*—verbal response with oral instructions.
Part *B*—verbal response after illustration and reinstruction.
Part *C*—Finger response to visual word.
Part *D*—Finger response to auditory word.

Discussion.—From the nature of the responses of the first two groups in the first two parts, it is reasonably certain that, when the visual word 'green' was flashed in Part *C*, there was an implicit verbal response 'green.' The subjects were definitely trying not to be 'tricked' a second time, but the habitual verbal response to the word 'green' was nevertheless set off. All these subjects made a flexion to the visual word in part *C*. There seems but one way of interpreting these results and that is essentially the same as suggested in the explanation of the double closing of the key in the multiple reaction experiment. As the color green is presented, there is also an implicit naming of this color. This implicit verbal response had preceded the finger flexion some 80 to 130 times in the five to seven minutes of Part *C*, and should from what is known of the conditioned response have become a substitute stimulus capable of setting off the finger response. When, then, the word green was presented, since it set off the verbal response, it also set off the finger response. It might be mentioned here that in preliminary work in which six subjects were employed other words were used with no evidence of flexion, although the word green did result for them also in flexion. It seemed unnecessary, then, to use words other than green in later experimentation.

The first of these two groups gave a flexion also to the auditory word green (Part *D*) while the second group did not. There has been reason to believe that a word heard is implicitly repeated and unless this is the case it is practically

impossible to understand why the flexion should have been made by these seventeen subjects as well as the two in Group 4. For some of these subjects other words were called out but no flexion ever resulted except for the word green. This eliminates the possibility of explaining the flexion as a 'shock' response. Besides, the typical 'shock' response involves contraction in both flexors and extensors, while for these subjects the flexion in practically all cases was as full as to the color green. Here again the flexion is to be explained apparently only through the intermediation of the verbal response.

As to the reason that no flexion was given to the auditory word by the second group, nothing final can be said. It may be that these individuals do not possess the tendency to repeat heard words. The experimenter had no technique at hand to determine whether this was the case, but he is inclined to doubt it. Three of these subjects who did not give flexion in the regular procedure were given four ten-minute additional practices in responding to the color green. During the fourth practice the word 'green' was called out and in two cases resulted in flexion. This would indicate that they did repeat the word heard but that the verbal response was not sufficient to set off the finger response in the first instance. The reason that the verbal response made to the auditory word was not so potent in setting off the finger response as the verbal response made to the visual word is found chiefly in the fact that the sensori-motor adjustment for the reception of a visual stimulus was high, since the subject had for some time been responding to this sort of stimuli, while the adjustment for the reception of an auditory stimulus was low.

All the above reasoning is more conclusively substantiated by the lack of flexion in Part *C* by groups 3 and 4. As a result of the reinstruction given between parts *A* and *B*, the verbal response given in part *B* by these subjects was the color of the background on which the word appeared. (This background was almost identical in composition with the yellow signal being the unfiltered light produced by an

opalite bulb.) Thus, the verbal response given when the word 'green' appeared in Part *C* was one that would not theoretically be expected to cause a flexion and in no case did so.

Besides the data summarized in the table, data were taken on three individuals with considerable practice. One individual after six ten-minute periods was handed a book and asked to read aloud a paragraph in which the word green occurred. A very small amount of flexion occurred as nearly as the experimenter could tell simultaneously with his pronunciation of the word green. Another subject after six periods was given a paragraph to read silently in which the word green occurred. No flexion was evidenced. After six more periods, however, a slight flexion was made, and immediately the experimenter said 'stop' and inquired as to the last word read. The word 'green' was the third from the last word. The third subject after fifteen practice periods, having been tried on the sixth, ninth, twelfth, and last period, gave no flexion. He reported some time later that his verbal response in practice had been 'color green' which may account for the lack of flexion.

Summary.—Data have been presented from two related experiments that are readily interpretable only if it be assumed that the individual is almost constantly making verbal responses and that these responses play a large part in setting off overt responses. This evidence supports the behaviorist's conception of the word as a stimulus.

It has been shown that three stimuli—color-green, printed-word green, and spoken-word green, of widely different physical composition set off the same verbal response and through this the same finger response. This is a laboratory example of Weiss' distinction between biosocial equivalence and biophysical equivalence.[5]

[5] Weiss, A. P., 'A Theoretical Basis of Human Behavior,' p. 78.

SONANCE AS A FORM OF TONAL FUSION [1]

BY MILTON METFESSEL

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Physics and psychophysics have always regarded fusion of pitches and their intensities as a simultaneous subjective phenomenon, dependent on the form of the molecular motion energizing the ear. This concept of tonal fusion has been built up in terms of a single sound wave. Timbre (tone-quality, tone-color, or quality), has been defined as a simultaneous fusion of pitches, and has been considered as the unique variable quality of the clang, or single complex tone.[2]

Ladd and Woodworth state that ". . . tone-color is determined by the character of the overtones which are blended with the fundamental tone," [3] and "each sensation of a clang is a summing-up in consciousness of several absolute qualities of musical sound; the stimulus which occasions this complex subjective state is a complex sound-wave made up of the contrasts and coincidences of several single waves that have the character of simple pendular vibrations." [4] Miller writes that "Since pitch depends upon frequency, and loudness upon amplitude (and frequency), we conclude that quality must depend upon the only other property of a periodic vibration, the peculiar kind of form of the motion . . . ." [5] Miller states that Helmholtz's law of tone-quality is: "The quality of a musical tone depends solely on the number and relative strength of its partial simple tones . . . ." [6] Seashore explains that ". . . psychologically, timbre is to be understood and explained as a complex of pitches fused into

[1] The writer wishes to acknowledge indebtedness to Professor C. E. Seashore for crucial suggestions.

[2] Ladd and Woodworth, 'Elements of Physiological Psychology,' 1911, p. 314.

[3] *Idem*, p. 314.

[4] *Idem*, p. 319.

[5] 'The Science of Musical Sounds,' 1916, p. 59.

[6] *Idem*, p. 62.

a single tone; and . . . physically, timbre is expressed in terms of the form of a sound wave." [7] Also, "the form of the wave is due to the number of overtones and their relative intensity." [8]

These references probably adequately sample the current concept of tonal fusion as it relates to timbre. Recent experiments seem to justify the designation of the experience dependent on the form of the sound wave in a clang agreed upon by the authorities above, as simultaneous tonal fusion, or *timbre*, but would also authorize a structural distinction from a successive tonal fusion, or *sonance*, found to be present in tonal perceptions. Actually there is no experience without both types. The term *sonance* is suggested as applicable, since it has no accepted scientific status, and has a dictionary meaning of 'quality of sounding.' [9]

An instance of the latter type of tonal fusion may be taken from some voice phenomenon, such as the vibrato. In the voice of the vocal artist there is present, over and above the number and prominence of the various partials in the individual waves, a recurrent increase and decrease of pitch and intensity of all partials at a rate of about seven times per second, with a fundamental pitch extent of one half a tone on the average. At times, superimposed on these recurrent synchronous pitch and intensity changes of about seven a second, there are faster and less extensive changes of the same type. Thus there is a periodicity within a periodicity.

Figure 1 shows graphically a snatch of an actual voice tone of a university student (B.B.) photographed and measured by apparatus and technique described by Simon,[10] and by the writer in a previous article.[11] 1*A* represents the fundamental pitch fluctuations, in terms of wave-lengths, of a part of a tone .36 second in duration, and 1*B* the fluctuations of the

[7] 'The Psychology of Musical Talent,' 1919, p. 128.

[8] *Idem*, p. 138.

[9] Craigie and Bradley, 'A New English Dictionary,' 1919, 9, Pt. 1.

[10] 'The Variability of Consecutive Wave Lengths in Vocal and Instrumental Sounds,' Iowa Studies in Psychol., PSYCHOL. MONOG., 1926, 36, (no. 167), pp. 41–83.

[11] Metfessel, M., 'Technique for Objective Studies of the Vocal Art,' Iowa Studies in Psychol., PSYCHOL. MONOG., 1926, 36 (no. 167), pp. 1–40.

same tone in breath pressure, (in this case indicative of relative loudness) as measured in terms of deviations from an assumed average base line. The two are arranged so that the same wave is plotted for breath pressure changes directly below that for pitch.

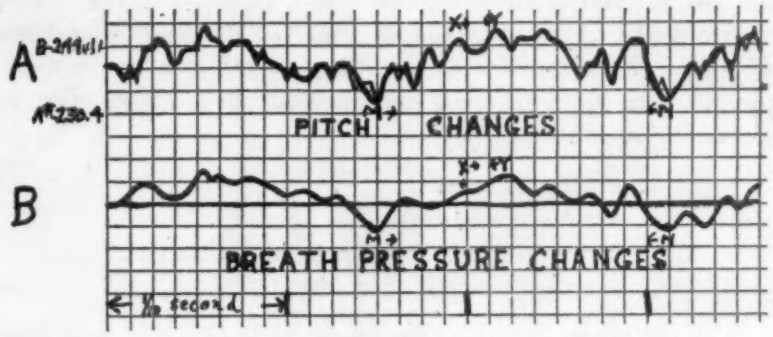

FIG. 1

The successive sound waves so graphed are thus changing very rapidly in both pitch and intensity, and in so doing are found in definite patterns. There are 87 sound waves plotted on the graph, with 40 in the large oscillation, *M* to *N*, and an average of 6 for the small oscillations as from *X* to *Y*.

When such phenomena are found in the voice, observers are agreed under experimental conditions that there is a certain pleasing liveliness about them. Their reports show that a tone of such a physical makeup results in quite a different experience from that of any one sound wave within it repeated for the same length of time.

Such fundamental pitch and intensity relationships as are shown by the heavy black curves in Fig. 1 were built up synthetically by means of cardboard sirens. The procedure was as follows: A siren with holes of variable distances (as determined from the graph) was constructed. A second siren was made in which the pitch was constant at the mean pitch of the other siren, but with the size of the holes varied until three observers were agreed, with their attention fixed upon

the prominence of pulsations (acquired by training), that the perceptive prominence of the two sirens was about the same as far as pulsations were concerned. These two were then united into a third siren forming a combined fundamental pitch and intensity fluctuation similar to the wide line in Fig. 1. A fourth siren repeated the pitch and, relatively, the intensity of wave No. 1 in Fig. 1. All four were then placed on the same disc so that they might quickly be compared. The order of their arrangement from outer edge in was as follows:

1. Pitch changes.
2. Intensity changes.
3. Combined pitch and intensity changes.
4. Single pitch and intensity.

The tones were sounded for one second duration, one after the other, from the outside in to the inside out, as many times as were requested by the observer, who knew nothing about their nature. Ten graduate students in psychology and speech were individually asked to describe whether the tones were alike in *timbre*, although as defined by the authorities above, the timbre resulting from the blast of air through the holes of the siren was the same in all four cases.

Yet the observers unanimously decided that what they heard and named as timbre in each case was different. Eight of them were not aware of any pulsations as such existing in the tones until they were pointed out. The two who heard pulsations were acquainted with the work of the laboratory on the vibrato, and they reported that they were expecting their appearance. Their reports however did not distinguish the tones as various types of pulsations, but rather, as stated above, as changes of *timbre*.

The interpretation of these reports obviously would suggest that these latter two changed their *Gestalt* by concentration on the pulsations as such. The others perceived the tones as a whole with a resultant fusion of both simultaneous and successive pitch and intensity relationships. It would thus seem that singing tones of artists are perceived

as units by most of the listeners, since the lay interpretation is, in their terminology, 'tone quality,' with no distinction between simultaneous or successive timbre fusion. Trained observers on the other hand are able to distinguish between *timbre* and *sonance*.

An empirical example of these facts is found in the attitude of the artists themselves towards the vibrato. They recognize the vibrato not as a recurrent pitch and intensity pattern but as yielding an emotional tinge to the tone. They sometimes call it 'the soul' of vocal music. Their perception has been one of combined *timbre* and *sonance*, rather than these two separately.

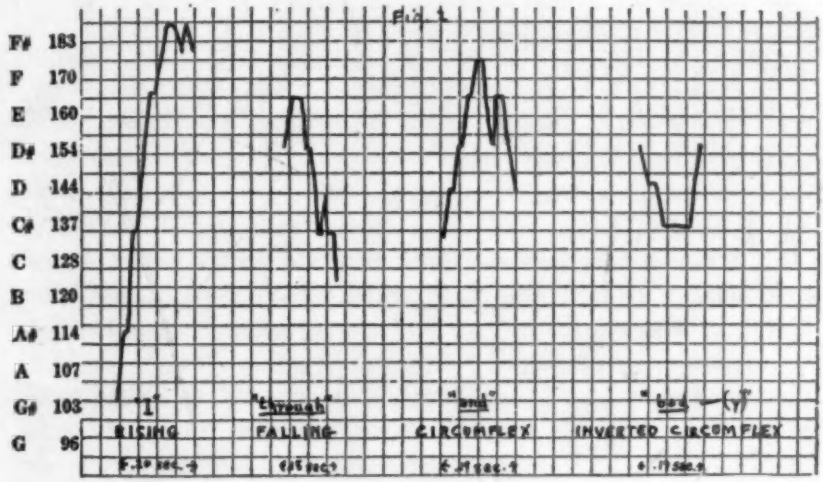

FIG. 2

In speech also there are recognized patterns of fundamental pitch and intensity change, fused ordinarily into a combination of *timbre* and *sonance*. Figure 2 shows the pitch fluctuation in four types of patterns determined by a photographic study of the pitch variations in Bryan's speech on 'Immortality,' Victor Record No. 16168-B. These are rising pitch, falling pitch, circumflex, and inverted circumflex.

These four types were converted into sirens also with the mean pitch in each case 140 dv. The ten observers were all

agreed that the so-called *timbre* in these various speech-pitch patterns was not alike in any two tones. Thus types of intonation in speech from the perceptive standpoint are classified as *sonance* in the sense defined above.

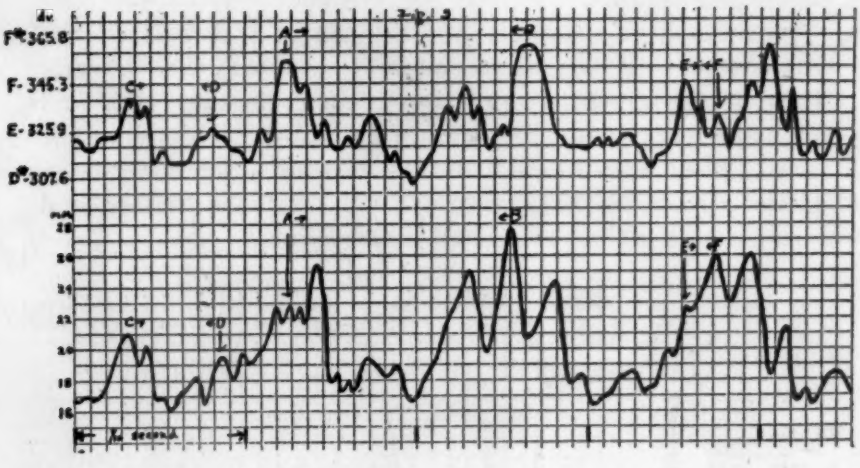

FIG. 3

To make this general distinction of tonal fusion more evident, let us take the example of the tone sung by Galli-Curci in the expression of excitement photographed from Victor phonograph record No. 74532 (Fig. 3). The horizontal distances representing one-tenth of a second are blocked off at the bottom of the graph. The upper curve shows changes in pitch, and the lower, synchronous changes in intensity as measured by the height of the fundamental wave. Vertically three small squares are indicative of a half tone. The intensity measurements are not absolute, but as photographed in this instance, a single square vertically is one millimeter change in the height of the wave.

There are at least three different types of recurrent patterns present. The general pattern *A* to *B* has within it patterns as from *C* to *D* and from *E* to *F*.

The analysis of this tone will be as follows:

1. Each single wave form (not shown on the graph) constituting a part of the voice is a fusion of various pitches

with their different intensities which are sounded at the same time from the vocal cords, and modified in the resonators above. The subjective result is that of simultaneous tonal fusion, or *timbre*. The ear receives this impression as such.

2. But our experiments show that there is also a complex union of the pitches, intensities and timbre of the successive waves with each other within one attention span in ordinary perception. As shown in Fig. 3 a train of waves from the voice takes on particular forms of fundamental pitch and intensity change (probably the same relatively in the overtones.) If the pitch variation in Fig. 3 were changed into a constant pitch and the intensity pattern alone sounded, the experience would be totally different from the way the tone is actually sung. In fact any change in the form which the successive pitches or intensities take on would cause a change in perception. This is examplary of successive tonal fusion, or *sonance*.

On each succeeding wave in this example (not demonstrated in Fig. 3) there are certain likenesses as well as differences. The vowel is the same, and as well, the personal voice traits of the singer. There are thus constants and variables in successive tonal fusions. Liddell [12] ventured without experimental psychological data that 'vowel quality' is a resultant of a group of loud partials in a series of waves. The phenomena he mentioned would be classified as one kind of constant in the phenomena we are calling *sonance*. The constants with respect to successive tonal fusion would be those factors present in a wave series which would still remain in experience if any single wave in the train were isolated and repeated, assuming that the tone permits of perception as a unit. All other factors would be variables.

Conclusions

Functionally, perception of tone in a single clang is the combination of two distinguishable types of fusion: (1) Simultaneous, or the fusion of pitches and their intensities

[12] 'The Physical Characteristics of Speech Sound,' *Engineering Bull.*, 1924, No. 16, p. 8.

in the single sound wave, (*timbre*), and (2) successive, or the fusion of pitches and their intensities of successive waves over and above the fusion in a single wave in one perceptive unit (*sonance*).

Successive tonal fusion may contain (1) certain constants in perception such as 'vowel quality' or personal voice traits, and (2) variables, exemplified by the vibrato and other periodicities in singing, and intonation types in speech.

THE PSYCHOLOGY OF COMPENSATION

BY WAYLAND F. VAUGHAN

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The integrity of the personality depends upon the successful maintenance of a state of equilibrium among the conflicting forces that threaten to destroy the balance. Pleasure and pain, egoism and altruism, materialism and idealism, all strive to establish themselves in experience. Needs upset the psychic stability; their fulfillment marks its restoration. Avenarius illustrates the principle of equilibrium in discussing attention. A problem arouses a man's interest; he becomes restless under the perplexity; the solution of the problem restores his peace of mind.[1] The feeling of inferiority indicates the presence of a need or problem for which compensatory activities seek a satisfactory solution. Old age, youth, wealth, poverty, health, and sickness all have their typical modes of compensatory behavior. Mental health is preserved by minimizing the disturbing influences which deficiencies exert upon the mind. Compensation is a defence reaction.

Compensation is essentially a resolution of conflicting impulses. "As a mental mechanism, motivating conduct and moulding personality, compensation ranks high in importance."[2] Its manifestations are familiar to every observer of human nature. Socrates remarked that his flat nose permitted him to see better. The blind develop a supernormal tactual sensitivity because they must rely upon their touch sensations to guide them. A man who has poor eyes cannot read widely but where his knowledge may be lacking in the breadth of its perspective it may be superior

[1] Bush, W. T., 'Avenarius and Pure Experience,' *Arch. Phil.*, 1905, No. 2. Rignano's principle of physiological invariability and Ribot's law of organic correlations are other statements along the same line.

[2] Pratt, G. K., 'Your Mind and You,' p. 21.

in the depth of its penetration. Nature is so resourceful that where its powers fail in one direction other means of adaptation are made available. "Deaf children are actually at an advantage in certain respects when compared with normal youngsters; they have greater powers of concentration and, as their education is developed manually, they train into excellent craftsmen."[3] Thomas Edison is somewhat deaf in his right ear. His defect, he says, has enabled him "to pursue his investigations undisturbed in the midst of hammerings, conversation and a hundred-and-one noises that might have disturbed him had he possessed undisturbed hearing."[4]

Before proceeding further I would like to point out a distinction in temporal or causal sequence between two cases: (1) An inferiority that leads to compensation. (2) The hypertrophy of one faculty resulting in the atrophy of others, due to specialization. The first case is illustrated by the fact that Edison's defective hearing was compensated by increased powers of concentration in thinking—the defect precedes and is a causal factor in producing the compensation. The second case can be explained in reference to Edison's social life. "Mr. Edison has few friends. Because of his work he has had to live a great deal by himself and in himself—shut out from the social contacts open to most men. There is probably no other living man of world consequence so isolated from normal society."[5] Let us assume that it was the intense application to his work that deprived him of social life, and not that the lack of social graces led him to devote himself to his research. The hypertrophy of his inventive powers, then, has resulted in the atrophy of his social propensities. In case 1, atrophy was a conditioning cause of hypertrophy; in case 2, hypertrophy was a conditioning cause of atrophy. It is possible that in another man social deficiencies, such as the lack of conversational poise or the possession of a melancholy disposition, would lead him to give all of his time to

[3] Lord Eustace Percy: Address as President of the British Board of Education, Aug., 1925.

[4] See *Literary Digest* for Aug. 8, 1925.

[5] *Ibid.*

his work—so that, with the temporal sequence the reverse of case 2, the same improvement in productive labor is present. The distinction is an important one for the interpretation of biographical material, for in some cases it may appear that inferiority led to compensation, whereas, actually, the defect in one field was the result of specialization in another. Often, however, the situation is a vicious circle,—social inferiority leading to intensive work, intensive work aggravating the social handicaps, and then the increased social inferiority ending in even more intensive work. No legitimate interpretation of motives can be made without taking into account the temporal sequence of events.

Compensation may be conscious or unconscious. The fundamental nature of the compensatory process is clear in multiple personality, where the operations are carried on, to a large degree, unconsciously. Mary Reynolds suffered from reciprocal somnambulism. There were two personalities, *A* and *B*. *A* was dull, unenterprising; *B*, lively, independent. *A* and *B* were, therefore, complementary—what the one had, the other lacked. This reciprocal relation is characteristic of compensation.

Compensations may be divided into the physiological and the psychological. The differentiation is merely an artificial one, since it is impossible to state how far psychical factors are concerned in any compensatory development. With this point in mind, the classification is a useful one. Physiology abounds with evidence of the important rôle that belongs to compensation. When a man proceeds to a high altitude, the diminished supply of oxygen is rendered innocuous by an increased amount of hemoglobin. "As the pressure of oxygen falls in the surrounding air and the supply of oxygen to the body becomes imperilled, compensation is effected by the increased activity of the red marrow sending out more corpuscles to act as carriers of oxygen."[6] Nature has provided mechanisms to preserve life in emergencies. A patient who is unable to breathe (functional disorder of

[6] Howell, W., 'Textbook of Physiology,' pp. 439–40. For further illustrations of compensation, see pp. 198, 406, 513, 625, 683.

respiration), faints from asphyxiation. With consciousness gone, the respiratory centers of the medulla resume their function, and breathing recommences. Life, which consciousness has been powerless to maintain, is preserved by the unconscious. Cannon, McIver, and Bliss, in an experiment on a denervated heart have shown how the adrenal mechanism comes in as a protection against the reduction of blood sugar below a critical point by insulin. The decrease of blood sugar below a critical concentration stimulates the sympathetic system. Adrenalin is secreted which liberates sugar from the reserves in the liver into the circulation and thus the equilibrium is restored, protecting the organism against the inadequate sugar supply that would mean death.[7] Cerebral compensation is a familiar phenomenon. When one cortical area is injured so that it cannot function, another area on the cortex may take on the extra work.

The capacity for compensation is characteristic of living tissue in general. The compensatory function is a part of nature's power of adjustment. The symmetrical types of organ are especially illustrative of this adaptive process. If one kidney is incapacitated, the other kidney assumes the extra burden. The extra work would be exhausting, were it not for the fact that the healthy kidney grows larger and stronger, so that the added responsibility is shouldered without undue strain upon the organism. The lungs demonstrate the same law of compensation. If one lung is weakened by injury or disease, the other lung develops a supernormal strength which enables the body to adjust itself to the demands of the environment, despite its defects. The harmfulness of a leaky valve in the heart is minimized by an increase of muscular power, so that the circulation is kept up to an adequate standard. The therapeutic principle of reëducation makes use of the compensatory capacities of the nervous system. "In the educational treatment of tabes, we do not influence the degenerated portions of the spinal cord, but we merely train other parts of the nervous system

[7] Cannon, W. B., McIver, M. A., Bliss, S. W., 'A Sympathetic and Adrenal Mechanism for Mobilizing Sugar in Hypoglycemia,' *Amer. J. Physiol.*, 1924, 69, pp. 46–66.

to take on those activities which the diseased spinal cord is incapable of carrying out." [8] Taking compensation in a broad sense, the regeneration of tissue is also a case in point. Life demands resourcefulness and nature's power to compensate is her answer to that demand.

Psychological compensations fall into the direct (compensation in kind) and the vicarious (compensation by substitution). Direct compensation means that the individual devotes himself to the strengthening of his weakness. The poor boy strives to become wealthy, the ignorant to become learned, the vulgar to become refined, the weakling to become an athlete. Demosthenes' conquest of his stammering is a well-known case.[9] Robert Hall became a great preacher in spite of asthmatic difficulties that made his early public utterances a failure. Russell H. Conwell's first attempt at oratory ended tragically. In a school debate he forgot his speech and after a long pause, he shouted, "Give me liberty or give me death," the only words he could summon to cover his confusion. Perhaps that early humiliation reinforced his determination to become a successful orator. In mentioning the auditory deformity which oppressed Bruckner, Adler says, "Bruckner as well as apparently all great composers has attained a remarkable artistic height in striving to conquer the auditory inferiority and transforming it into inventive, creative hearing." [10] Kant, with his sunken chest, and gout, was discouraged under the burden of his pain and hypochondria. His courageous effort to rise above his physical ailments and to be "calm and clear in the head" was given expression in his essay, 'The Power of the Mind, Through Simple Determination, to become Master over Morbid Ideas.' "His attack of gout thus became for Kant a source of inner investigation and from this source issued a

[8] Coriat, I., 'Religion and Medicine,' p. 258.

[9] "Often a morphologic or functional deficiency of an organ is converted to a higher development of that organ. . . . We seldom find any such heaping up of defects of speech and signs of degeneration of the mouth, as are observed in orators, actors, and singers." Adler, A. 'Organ Inferiority and its Psychical Compensation,' p. 22.

[10] *Ibid.*, p. 37.

new stream of wisdom." [11] Phillips Brooks failed as a teacher because he could not keep discipline and he turned to the ministry as his life work. He was told at the time that he would never make a success as a preacher, since he was troubled with a speech defect. How he lived to disprove the truth of that prediction is an inspiring story.

Vicarious compensation is probably more common than the direct because it is not so difficult to accomplish. An individual who realizes that he is deficient in one field sets out to conceal that incapacity by training his ability in another direction. The weakling becomes a scholar, the plain woman develops a pleasing disposition, the bore practices thoughtfulness of others. Socrates made up for his homeliness and domestic indolence by cultivating a beautiful soul. When a man fails to succeed along general lines, he turns to the training of his special abilities as a refuge.[12] Maladaptation to the world of reality is apt to lead to autistic thinking where vicarious satisfactions are enjoyed. In some instances the joy of fantasy results in artistic success. In 'Lady Windermere's Fan,' Oscar Wilde seeks redemption from his own sins by showing in the character of Mrs. Erlynne that even a person who is reputably bad has his good points. Wilde thus works out his salvation for the moment in the realms of fantasy. Evolutionary development has followed vicarious trends. Mechanical perfection becomes less important where the brain is developed. Intelligence compensates for the lack of skill in movement. If a man can foresee a situation, he does not need to move so dexterously.

Vicarious compensation is often effected through sublimation. Social pressure frequently prevents a man from succeeding where his vocational inclinations lie. The energy that is repressed in one direction, may blossom out through other and more fruitful outlets. There we have vicarious compensation. A person who works hard in order to forget a disappointment substitutes a new road to happiness for the old one that has been blocked. New interests provide a

[11] Bjerre, P., 'The History and Practice of Psychanalysis,' p. 11.

[12] This fact has pedagogical significance. A teacher can be a great aid to a boy by uncovering and training his talents—guiding his compensation.

release from sorrow. Germany, under Napoleon's feet, produced the most optimistic and idealistic literature the world has seen. Similarly, Wagner composed some of his best music while he was suffering from melancholia. Heine confessed, "I stitch together a good many rhymes and many of them coax away my pain like magic when I hum them to myself."[13] Humor may be considered a compensation for sadness. It has been said of Shakespeare that "the spirit which held the woe of Lear and the tragedy of Hamlet would have broken had it not also had the humor of the 'Merry Wives of Windsor' and the merriment of the 'Midsummer Night's Dream.'" [14] Mark Twain was a very sad man in actual life, according to the testimony of his secretary.[15] Lincoln's humorous vein helped him to bear his sorrows with better fortitude. A Dr. Abernethy, in advising a patient who came to him to secure treatment for depression, said, "You need amusement; go and hear Grimaldi; he will make you laugh, and that will be better for you than any drugs." "My God, but I am Grimaldi," gasped the patient. Lessmann, the humorous writer who wrote the 'Journal of a Melancholic,' hanged himself in a fit of despondency. Molière had numerous attacks of melancholia. One can see how writing 'Le Médecin Malgré Lui' would banish his troubles. Irving describes a madcap undertaker who was inimitable at a merry song.[16] William Cowper wrote 'John Gilpin' while he was suffering from acute depressive insanity. His letters were gay and amusing. Cowper's moodiness did not prevent him from being entertaining. In fact, he confesses, "The most ludicrous lines I ever wrote have been written in the saddest mood, and but for that saddest mood, perhaps had never been written." [17] Humor has its compensatory function to discharge in the maintenance of the psychical equilibrium.

[13] Quoted by Shaler, S., 'Masters of Fate,' p. 139.

[14] Quoted by Barton, W., 'Life of Abraham Lincoln, II, p. 404.

[15] See Brooks, V. W., 'The Ordeal of Mark Twain.'

[16] Irving, W., 'Sketch Book,' p. 221. (Home Library ed.)

[17] Quoted by Gamaliel Bradford, 'Diversions of a Lost Soul,' *Atl. Mo.*, Sept., 1924, pp. 361–71.

Compensations may also be classified according to the types of inferiority that call for alleviation,—the physical, intellectual, moral, and social.[18] The direction of striving is determined by the nature of the inferiority and by the talents at hand awaiting development. Each type of compensation may be direct or vicarious, according to the situation. That is, the development of a keen intellect (intellectual) may be either a compensatory measure for stupidity (direct) or for a frail physique (vicarious). Each class of inferiority can be compensated through multifarious channels. The puny man may concentrate on a strong body (physical), on scholastic attainments (intellectual), on integrity of character (moral), or on good-fellowship (social); any one or several of these paths lie open to him.

Physical deficiency is a handicap that arouses the individual to seek a remedy of some sort. Theodore Roosevelt converted his sickly body into a powerful physique. Eugene Sandow was a weakling as a child. At the age of ten his father took him to Rome where he saw the statues of perfect men that inspired him to make his own body perfect. Although he had intended to be a priest, upon his return from Italy he commenced the study of anatomy, determined to build up his muscles by scientific methods. The training was so successful that he became a professional strong man. The feeble boy who had looked with awe upon the statues in Rome was in later life himself to pose as the model for one of the figures of a statue, 'Combat du Centaur' done by the noted French sculptor, Gustave Crauck.[19] Puny men are often noted for their energy and endurance. Nietzsche and Watt found vicarious satisfactions for their physical frailties. Nietzsche evolved the philosophy of the Superman and in the delineation of this ideal-being he delighted in the thrills of prowess denied him in real life. Watt was a sickly boy. When he had grown up, he became interested in applying

[18] K. A. Menninger divides compensations into perceptual, intellectual, emotional, and volitional. See Menninger, K. A., 'The Mental Effects of Deafness,' *Psychoanal. Rev.*, 1924, 11, pp. 144–56.

[19] 'How the World Went Mad over Sandow's Muscles,' *Literary Digest*, Oct. 31, 1925.

the power of steam. He worked on his invention against heavy odds, incurring debts that were extremely hard for him to settle. There must have been some powerful motive for his tireless perseverance. Steam may have appealed to him because it symbolized the triumph of spirit over matter, of mental ingenuity over physical inertia. Perhaps his struggle against his own bodily weaknesses was carried on symbolically in the conquest of steam. The weakly boy succeeded in minimizing the importance of his physical handicaps by harnessing one of the strongest forces of modern civilization.[20]

In the realm of the intellect the mechanism of inferiority-compensation also plays a determining rôle. Lombroso describes genius as an overcompensation for an inferior brain. We need not go to such an extreme doctrine to get evidence for compensatory processes. A young man of poor social standing may make a place for himself in society by becoming a scholar, for where intellectual ability is within a person's power, he cannot be denied the prizes of learning. Frequently, the unathletic boy makes an excellent student. Although intellectual compensations are largely vicarious, there are cases where the process is direct. A boy who comes from a highly educated family is apt to be impressed by his parents that he is gifted with superior intellectual capacities. Lack of interest in his studies, or other difficulties in the school situation, may deprive him of scholastic distinction. If he is of a proud nature, the disgrace will be a real one for him, however trivial the actual failure, and the humiliation will give him a new zest for study. In the career of the late Lord Curzon there came a most suitable stage for the entrance of an extraordinary urge toward intellectual preëminence. He was supercilious in his attitude towards other men and his whole conduct was colored with the consciousness of superiority. He could not appreciate a joke on himself. He could direct other men but he could not defer to them. As a viceroy in India, he gave evidence of an extended capacity for self-admiration. For a man of

[20] Tanner A., 'Social Aspects of Invention,' *Amer. J. Psychol.*, 1925, 26, p. 415.

such high self-esteem, any slight defeat would mean bitter humiliation. "Nothing in all his life was more characteristic of the man than his display of energy and capacity when he missed the highest honors at Oxford. It stung him. He resolved on the instant to cover that failure with a glorious triumph. He collected a library of reference works on a certain subject, went out of England for an opportunity to work incessantly, returned to London for two weeks in the British Museum, and towards midnight on the last day for the delivery of essays for the Lowthian prize he hurried off in a cab with his own entry, which he handed to an official just within the time. He won that prize. A similar display of untiring industry later won him the Arnold prize. His memory was remarkable, his powers of concentration abnormal, his range of interests vast. He did many things well. All that he accomplished, moreover, had to be done under a certain handicap of physical poverty. He did not begin his struggle with the world with such an endowment of bodily powers as one might surmise he possessed. If only he could have won the affectionate devotion of his fellows as well as their admiration, if only he could have laughed as well as pose, he might have gone farther and higher, and at that there were few peaks left for him to scale." [21]

Moral inferiority is prominent where sexual irregularities prey upon a tender conscience. Immorality has a tendency to crop out in one direction while the individual is engaged in guarding another outlet. Sometimes writers who are chaste in their lives are licentious in their writings. An acquaintance of Flaubert remarked that "there never was so moral a man who loved immorality so much." Bad habits undermine a man's self-respect and he will resort to radical measures to regain his self-esteem. Some men conquer their sins by painting the strength of purity. Henley, the author of Invictus, was beset with physical temptation and when he announced "I am the captain of my soul," a friend protested, "The hell you are." Sadger points out that von Kleist made a constant theme of virtue as a refuge from his immoral

[21] *Boston Herald* Editorial, March 21, 1925.

habits. Clinical experience leads Sadger to believe that youthful preoccupation with the subject of virtue is often an overcompensation for the childhood sin of masturbation.[22] Wordsworth, in atonement for the sexual dissipation of his youthful days in France, became the most severe moralist in the poetical writings of his later days.[23] The most effective way to conquer temptation is to turn your back upon it and to cultivate other interests, such as those one finds in religion. Many saints spent their youth in 'wild living,' Lazzaretti, Loyola, Assisi, Augustine. Conversion is apt to be followed by a violent reaction to a morbid extreme of holiness. Pascal, repenting his sensual youth, came to deem his mother's kiss a crime. John Bunyan's conscience was so acute as to approach the borderland of disease. Among his most terrible sins, according to his own word, were the ringing of bells, dancing, hockey, swearing, lying, and blaspheming. Even in his childhood the Lord "did scare him with fearful dreams and visions." He found redemption from his 'original and inward pollution' in the blood of Christ. "Christ was a precious Christ to my soul that night; I could scarce lie in my bed for joy and peace and triumph through Christ." [24]

Compensations for social inferiorities cover many different directions, since there are so many reasons why a person may feel socially inferior—poverty, manual labor, exclusion from societies, lack of poise in company and so on. It is sometimes a blessing that a boy cannot be a 'good fellow,' for his limitation keeps him from frittering away his nights in dancing and spending his days in a half-doze. Howe, Arkwright, and Whitney had to endure the taunts of the people while they worked on their inventions. Public ridicule imbued them with the determination to see the task through to a successful conclusion in order to vindicate the possibility of their conceptions, and to prove their sanity. Martin Luther, during his early days in the monastery, was a humble monk, fasting and praying for salvation. In contrast, his

[22] Sadger, J., on H. von Kleist. See *Amer. J. Psychol.*, 1916, 27, p. 384.

[23] Legouis, E., 'Wordsworth in a New Light.'

[24] Bunyan, J., 'Grace Abounding to the Chief of Sinners.' Quoted by James, W., 'Varieties of Religious Experience,' p. 158.

later life was marked by a conviction of righteousness and a fearless aggressiveness. Through the Protestant Reformation he gained an opportunity to burst from his insignificance by defiantly burning the papal bulls. The meek son of a peasant had the audacity to declare himself on a par with the head of the Roman Catholic Church. Luther enjoyed his rise to prominence all the more because in his youth he had been denied any outstanding influence in his community by virtue of his low social position.[25] Thoreau was a lonely man. Though he was a solitary person, he possessed a compensating joy in the love of nature. In the appreciation of nature his sensibility was as broad and sensitive as it was narrow and unresponsive in relation to men. "In the midst of the gentle rain . . . sensible of such sweet and beneficent society in Nature, in the very pattering of the drops, and in every sight and sound around my house" I found "an infinitive and unaccountable friendliness" which "made the fancied advantages of human neighborhood insignificant."[26] It was given to Thoreau with his isolation from men to disclose to us the beauties of the world of nature with such a sympathetic insight as is unknown to the man who depends upon social contacts for his happiness.

Allport lays down four criteria of compensatory traits. (1) They originate from an obstacle, defect, or limitation. (2) Further adjustment of the individual is effected, not by trying to adapt reality to his own peculiarities, but by adapting his capacities to reality. (3) These activities become not merely so many separate acts of adjustment but prepotent habit trends, or drives, which in time appear as ends in themselves. (4) Since these habit trends become controlling forces in themselves, they tend to carry the individual past an adjustment which is simply adequate, to higher levels than he would have attained without the original defect.[27] Take Rousseau, for example. He could not get along with anybody on account of his extraordinary

[25] See Pruette, L., 'Some Applications of the Inferiority Complex to Pluralistic Behavior,' *Psychoanal. Rev.*, 1922, 9, pp. 32–33.

[26] Thoreau, H., 'Walden': Solitude.

[27] Allport, F. H., 'Social Psychology,' p. 115.

vanities and caprices and his extreme sensitiveness. To gloss over his social inadequacy he developed a sentimental love for all mankind, and "by his very extravagances he was able to make an impression on the artificial age in which he lived, of which a more balanced nature might have been incapable." [28]

Where inferiority leads to extraordinary achievement, it is through the process of overcompensation. Compensation gains a momentum as it proceeds which carries the development to supernormal stages, heights to which the individual never would have attained except for that momentum originally imparted by the sense of inferiority. The analogy of the pendulum is apropos. If a person possesses no defects of sufficient magnitude to instil a real sense of inadequacy, there is no compensatory push to start the pendulum swinging. Where there is a feeling of insufficiency, the pendulum is drawn back and released; compensation sets in. The momentum of the downward swing carries the bob past the point of rest to a new and higher level, overcompensation. "The incentive in Byron," says a biographer, "was that mark of deformity on his person, by an acute sense of which he was stung into the ambition of being great." [29] Such zeal will not be denied. Great men are famous for their faults. Shortcomings, of course, stand out against the background of superiority. This contrast is the essence of compensation. As we have seen, deficiency has its part to play in the evolution of greatness. Weakness in the leader gives him a point of contact with his followers; compensation makes it possible for him to keep in advance of them. As Nietzsche puts it, "The greatest men may also perhaps have great virtues, but then they also have the opposites of these virtues. I believe that it is precisely out of the presence of these opposites and of the feelings they suscitate, that the great man arises—for the great man is the broad arch which spans two banks lying far apart." [30]

[28] Rogers, A. K., 'A Student's History of Philosophy,' p. 400.
[29] Moore, T., 'Life of Byron,' p. 306.
[30] Nietzsche, F., 'The Will to Power,' II, p. 370.

PLAYING SCHOOL—A COMPENSATORY MECHANISM

BY HARVEY C. LEHMAN AND PAUL A. WITTY

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The writers have called attention to certain conspicuous differences between white and negro children. It was demonstrated that negro children tend to engage more generally in church activities than do white children (1). Analysis of extensive play data showed that negro children engage more frequently than white children in social plays and games (2). They tend to avoid individual activities.

Witty and Decker found that negro children were educationally retarded in all subjects at all ages when comparisons were made with the educational achievement of white children (3). Yet, analysis of play data reveals the surprising fact that negro children tend to play school much more frequently than white children. As negro children are conspicuously unsuccessful in academic endeavor, it seems paradoxical that they should play school more frequently than their more successful classmates. One would naturally expect the Negro to turn during his leisure hours to activities in which he can best succeed and to avoid those for which he manifests restricted ability.

The following paper reports the frequency with which representative white and negro children engage in playing school.

Method.—Over 5,000 children were asked to check from a comprehensive and catholic list of play activities *only those* in which they had engaged during the preceding week. The directions were specific and data were secured from unselected pupils. In order that seasonal differences in play behavior might be taken into account the list was checked by the children on each of three different dates, November 7, 1923, February 20, 1924, and April 30, 1924. One of the items

included in the list was 'Playing School.' Analysis of the data gave evidence of a conspicuous race difference in response to this item. The number of Negroes included in the initial study was small. To verify the finding in reference to 'Playing School,' additional data were secured in January of

TABLE I

NUMBER OF INDIVIDUALS INCLUDED IN THE PRESENT STUDY

Boys

Ages	Nov. 1923		Feb. 1924		Apr. 1924		Nov. 1924	Nov. 1925	Jan. 1926	
	W.	N.	W.	N.	W.	N.	(Rural) White	(Rural) White	W.	N.
8½	72	26	71	19	—	—	89	35	100*	39
9½	132	28	128	33	115	29	102	45	100	75
10½	138	44	135	34	128	32	102	67	100	94
11½	155	32	138	29	151	33	106	65	100	89
12½	200	40	161	40	137	39	101	79	100	104
13½	235	45	183	48	208	51	93	70	100	80
14½	215	59	215	37	194	44	67	50	100	48
15½	183	47	198	49	196	51	46	22	100	40
16½	210	—	181	—	193	—	—	—	100	—
17½	145	—	130	—	146	—	—	—	68	—
18½	115	—	170	—	130	—	—	—	22	—
19½	95	—	119	—	102	—	—	—	—	—
20½	50	—	73	—	59	—	—	—	—	—
21½	53	—	57	—	43	—	—	—	—	—
22	79	—	105	—	68	—	—	—	—	—

Girls

8½	74	26	59	27	—	—	85	39	100*	48
9½	146	28	112	27	118	26	85	49	100	90
10½	183	32	153	46	142	34	103	53	100	123
11½	198	37	176	46	171	49	109	64	100	114
12½	249	77	255	34	213	53	83	69	100	110
13½	209	60	189	46	200	63	89	57	100	91
14½	258	43	237	45	213	65	68	35	100	71
15½	191	70	188	56	191	65	27	21	100	34
16½	251	—	223	—	235	—	—	—	100	—
17½	182	—	208	—	193	—	—	—	100	—
18½	120	—	174	—	167	—	—	—	50	—
19½	101	—	115	—	93	—	—	—	—	—
20½	73	—	124	—	76	—	—	—	—	—
21½	41	—	85	—	66	—	—	—	—	—
22	44	—	114	—	88	—	—	—	—	—

* Data were assembled from a much larger number of white children in Kansas City, Missouri, but it was decided that 100 cases would be sufficient to provide a fair sampling of the returns.

1926 from 6,000 pupils in Kansas City, Mo., 480 negro boys and 681 negro girls. As the results of the final investigation corroborate the initial findings, data are presented only for the study of January, 1926. The number of white children and negro children included in the various investigations are presented by sex and age in Table I.

Table II, and Fig. 1, show the percentages of boys and girls of each race who engaged in 'Playing School' during the

TABLE II

PERCENTAGES OF CHILDREN WHO PLAYED SCHOOL DURING THE COURSE OF A WEEK

	Ages							
	8½	9½	10½	11½	12½	13½	14½	15½
Negro girls	81	61	60	47	41	32	21	21
Negro boys	41	40	29	21	15	8	2	5
White girls	57	41	43	35	19	9	6	1
White boys	13	9	11	5	3	3	0	0

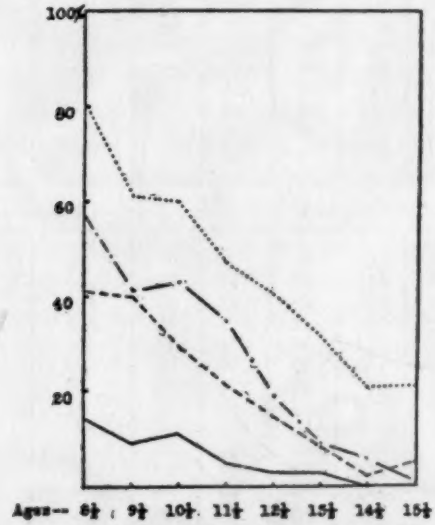

FIG. 1. Percentages of children who played school during the course of a week.

Negro girls - - - - - - - - - - - - - - - -
Negro boys — — — — — — — — —
White girls - — - — - — - — - —
White boys ———————————

course of the week preceding the investigation. The following facts are revealed: (*a*) Girls of both races engage in this activity much more commonly than boys. (*b*) Negro children participate in playing school more frequently at all ages than white children. (*c*) Both race groups participate less frequently in this activity as chronological age increases.

Remarks.—The relative inferiority of the Negro in actual school endeavor was commented upon previously. However, this investigation gives evidence of the relatively great frequency with which negro children relive school activities by playing school. What explanation is there for this condition? The following is offered as a likely hypothesis in this regard.

Probably none would deny that the Negro is cognizant of his inferior social status. Negro children doubtless are aware of their lack of social and intellectual prestige from very early ages. The writers suggest that the negro children engage in playing school more commonly than white children because this activity symbolizes to them knowledge, power, and prestige, which they are unable to achieve in the world of actuality. This form of make-believe play may be a compensatory activity.

Various writers have emphasized the compensatory nature of the day-dream or fantasy. Robinson insists that conscious shamming or make-believe play is "essentially a compensatory mechanism having the same origin and impetus as the day-dream or fantasy" (4). Every normal child must play because childhood is primarily a period of incomplete adjustment.

> "The child is driven by many inherited and acquired impulses, some of which are adequately and easily expressed, and some of which find no direct outlet. These latter create a situation demanding compensation, and this compensation is as a rule secured through make-believe activities. Most common among such activities are play and fantasy. A child would fight, hunt, and make a home as particular stimuli arouse him. He is seldom in such an environment, however, and he is practically never so organized by inheritance or training that these undertakings can

be fully carried out. There are inexhaustible inhibitors around him and within him which check free expression. And so he plays at, or has day-dreams of, fighting, hunting, and home-making. I have no desire at this time to say which of the unsatisfied impulses of childhood are inherited and which acquired: but, however they arise, we find that they are many and urgent, and consequently that every normal child must find compensation for their inhibition (4)."

Full of impulses to do actual things, the child is equipped with a physique and surrounded by an environment which are constant obstacles to success. In such cases we are apt to have a mimicry of feats of strength and daring. The satisfactoriness of the resultant make-believe play is sometimes increased by muscular, overt accompaniments. Robinson illustrates this fact by drawing upon his own boyhood experience:

"As a child I was full of baseball fantasies. Although I played baseball a great deal, these games did not satisfy certain standards set up by reading athletic stories and watching older and more skillful players. But the fantasies, too, often became unsatisfactory on account of their intangibility. As a result I formed the habit of laying out a diamond upon the lawn and there, without ball or playmates, carrying out the overt movements of an heroic baseball performance. Many a time, I pitched nine long innings to baffled athletes who swung immaterial bats at my imaginary curves. Here was fantasy improved and made realistic by the actuality of its muscular accompaniments" (5).

Common observation makes evident the fact that fantasy is sometimes improved and made more realistic by the presence of playmates. Reaney holds that organized group games may have a compensatory function (6).

The compensatory function of make-believe play is not ordinarily evident to the performer. Consciousness of inferiority is the very thing that the performer seeks to avoid. Success crowns the individual's efforts only when he forgets the unpleasant actuality which has given rise to the compensatory activity. It is probable that negro children play school as a compensatory mechanism. How then is one to explain the fact that boys engage less frequently than girls

in this activity? Data in possession of the writers show that girls' play does not extend over so wide a geographical radius as boys' play. Girls are not permitted to roam so far from home at the earlier ages as are boys. Girls must adjust their play activity to the indoor situation in which they find themselves. The differences between the sexes in native equipment plus the environmental restrictions to which girls are subjected offer a plausible explanation of the sex difference revealed in this regard.

With increased maturity both races and both sexes engage less frequently in playing school. This may be due to the fact that the satisfaction which is derived from compensatory behavior is dependent upon the extent to which the activity is reconcilable with the child's own credulity. It is likely further that increase in chronological age brings progressively greater opportunity to participate in diverse plays and games, some of which are intrinsically more satisfying than playing school. This would account in part for the decrease in participation in this activity.

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